METABOLIC EFFECTS OF EYESTALK REMOVAL IN *PENAEUS INDICUS* H. MILNE EDWARDS

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To my Parents

C E R T I F I C A T E

This is to certify that this Dissertation is a bonafide record of work carried out by Shri. B Rajesh under my supervision and that no part thereof has been presented before for any other degree.

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P R E F A C E

Ever since Panouse(1943) discovered that eyestalk removal led to premature ovarion development, eyestalk ablation technique has been used as a tool to induce maturation of prawns in captivity. Eventhough several workers used eyestalk ablation technique to induce maturation of penaeid prawns little attention has been given to understand the metabolic effects of eyestalk removal.

Studies on oxygen consumption of animals of economic importance are specially important since the energy requirements of the animal can easily be obtained from the measurement of its oxygen consumption. An estimate of ammonia excretion has been used as a measure of protein degradation in ammonotelic animals. Behavioural changes indicated by random(spontaneous) activity are important in studying energy utilization. Studies on the levels of carbohydrates in hepatopancreas and tissues are also useful in understanding the metabolic effects of eyestalk removal in crustaceans.

The penaeid prawn <u>Penaeus indicus</u> which is one of the great aquaculturally important species, was chosen for the present study. Oxygen consumption, ammonia excretiom, random activity and carbohydrate levels(in hepatopancreas and muscle) of adult intermoult *P. indicus* were studied immediately after eyestalk removal (unilateral and bilateral) and without eyestalk removal(control)at three temperatures and five salinities.

The oxygen consumption of *P. indicus* increased immediately after eyestalk ablation. The rate was found to increase with increase in temperature. The eyeablated females always showed a higher rate of oxygen consumption than the males. The rate of oxygen consumption of eye ablated *P. indicus* decreases with increase in salinity and it was found to be minimum at 25.7 ppt. This indicates that eyeablated *P. indicus* expends least energy at 25.7 ppt. In different salinities also the females consumed more oxygen than the males.

The rate of ammonia excfetion also increased after eyestalk ablation. The rate of ammonia excretion increased with increase in temperatures and decreased with increase in salinity. The minimum rate of ammonia excretion was found at 27°C and 32.4 ppt. This again suggests that protein degradation was minimum at 27°C and 32.4 ppt. The females exhibited higher rates of ammonia excretion than the males.

The ammonia quotients also decreased after eyestalk ablation in all the salinities and all the temperatures tested.

The random activity of eyestalk ablated (both unilateral and bilateral) increased after eyestalk ablation. The random activity decreased with increase in temperature and increase in salinity. The random activity was minimal at 25.7 ppt where the oxygen consumption was also minimal.

Eyestalk ablation resulted in an increase in the level of carbohydrates in the muscle tissue and a decrease in the hepatopancreas.

The above observations are discussed and compared with the work done on other crustaceans. The results of this study are of immense value in the brood stock management of this most commercially important prawn, *P. indicus*.

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INTRODUCTION

Metabolic studies have been found to have wide implication in aquaculture since by maintaining the optional oxygen and ammonia concentrations in the culture system, the costs of production can be optimised (Botsford and Gossard, 1978). Crustaceans form the most important group among the culturable organisms. Therefore, studies on the metabolism of commercially important crustaceans such as prawns are of immense value for aquaculturists.

Eyestalk removal technique has been in practice from the beginning of the 20th century. (Zeleny, 1905, Megusar, 1912; Abramowitz and Abramonitz,1938; Brown and Cunningham, 1939; Hanstrom, 1939; Abramowitz, and Abramowitz;1940, Smith, 1940; and Panouse, 1943). Later on various workers have devised and modified the techniques of eyestalk removal to understand its effect on various physiological processes.

The eyestalk in crustaceans contain the X-organ sinus gland complex which produces neurosecretory hormones that regulate the various physiological processes of the organism including lipid metabolism, protein synthesis and carbohydrate metabolism. Therefore, removal of the eyestalks affect the various physiological activities of the animals and these effects can be measured in terms of oxygen consumption, nitrogen excretion and random(Spontaneous) activity and also the changes occuring in the carbohydrate levels in hepatropancreas and tissues.

Oxygen consumption is a parameter often used as an index of metabolism and is therefore of basic importance. Oxygen consumption in prawns has been studied by several workers. (Lofts, 1956; Subrahmanyam, 1957, 1962; Kutty,1969; Kutty, et al.,1961; Reeve, 1969; Kuttyamma, 1980; Laxminarayana, 1980; Laxminarayana & Kutty,1982) but there are only a few studies on metabolism of eyestalk ablated prawns. Scudamore (1947) was the first to demonstrate that the removal of sinus gland within the eyestalk of the crayfish, Oreonectes immunis led to an increase in oxygen consumption and fufther injection of eyestalk extracts decreased the respiratory rate in destalked animals. Edwards(1980), Bliss(1953), Diwan and Nagabhushanam(1972) observed an increase in metabolic rate following eyestalk removal, in crabs. Effect of eyestalk ablation on prawns has been studied by Scheer and scheer(1957), Nagabhushanam and Kulkarni(1978) and Sarojini et al.,(1981). Nitrogen excetion in crustaecea is reviewed by Campbell(1973) and Riegel(1965, 1975). Several workers studied the nitrogen excretion in crustaceans (Reeve, 1969; Laxminarayana, 1980; Regnault, 1981; Laxminarayana and Kutty, 1982) but the studies combining oxygen consumption and ammonia excretion are few in crustaceans. Raghavaiah(1980) studied the neuroendocrine control of nitrogen metabolism in the Indian field crab, Oziotelphusa senex senex.

In most of the above studies on metabolism of crustaceans, random(spontaneous) activity as a factor has not been considered. The only available work on the effect of eyestalk removal on activity is that of Naylor and Williams(1968) in Carcinus. Comparison of metabolism is valid only when a measure of random activity is available as otherwise energy requirements can be widely different in different levels of random activity.

The role of endocrines in crustacean metabolism has received considerable attention and there are several reviews on this subject (Drach,1939; Brown,1944; 1948; Knowles and Carlisle,1956; Scheer and Meenakshi,1961; Johnson and Fisher, 1968; Keller,1974, 1975). Abramowitz et al.,(1944) for the first time reported the relation between the eyestalk principle and carbohydrate metabolism in crustaceans. Schawbe et al., (1952) studied the effects of eyestalk removal on glycogen content of epidermis in Panulirus japonicus. Neiland and Scheer(1953) found that there was no significant change in the glycogen concentrations following eyestalk removal and also after the injection of eyestalk extract. Diwan(1973) studied the effect of bilateral eyestalk extirpation on the glycogen and fat content of hepatopancreas and muscle tissue in Barytelphusa cunicularis. The other workers who contributed to the study on neuroendocrine control of carbohydrate metobolism in crustaceans include Scudamore (1947) in crayfish, Kleinholz and Little(1949) in Libinia emarginata, Kleinholz et al.,(1950) and Scheer and Scheer (1950-52) in spiny lobsters, Rangnekar et al.,(1961) in Paratelphusa jacquemontii, Rangnekar and Madhyastha(1971) in Metapenaeus monoceros, Parvathy(1972) in Ocypoda platytarsis, Hamann(1974) in crayfish and Rangnekar and Momin(1974) in Scylla serrata. Recent contributions on this aspect include the studies of Nagabhushanam and Kulkarni(1979) in Parapenaeopsis hardwickii and in Parapanaeopsis stylifera(1980), Ramamurthi and Venkataramaiah(1982) in Oziotelphusa senex senex and Rangnekar and Kolwalkar(1982) in Portunus pelagicus.

The Indian white prawn, Penaeus indicus, whose aquacultural importance is well known, was chosen for the present study. Oxygen consumption, ammonia excretion, random activity and changes in the carbohydrate levels(in hepotopancreas and muscle) of unablated, and ablated (unilaterally and bilaterally) Penaeus indicus (of size group 120-140mm) were studied in three different temperatures(27°, 30° and 33°C) and 5 different salinities (2, 8, 17.7, 25.7 and 32.4 ppt).

A measure of ammonia excretion is very important as an index of protein degradation. In the present study, relative changes in ammonia excretion and Ammonia Quotient(A.Q)* (Stroganov,1962; Kutty,1972; Laxminarayana 1980; Laxminarayana and Kutty,1982) have been investigated in different temperatures and salinities, to find out if temperature and salinity has any influence on the metabolism of unablated and ablated *Penaeus indicus*.

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* Ammonia quotient (A.Q) $= \frac{\text{Volume of Ammonia excreted}}{\text{Volume of oxygen consumed}}$

MATERIAL AND METHODS

I. a) Procurement of animals:

Penaeus indicus H.Milne Edwards(1937) was selected for the present study. For studies on Oxygen consumption, ammonia excretion, random activity and carbohydrate metabolism, prawns of the size group 120-140mm were selected. All the prawns used for the present investigation were collected from the brackish water ponds around Narakkal. Adult males and non-ovigerous females of intermoult prawns were used for the present study.

b) Maintenance of the experimental animal stock:

The prawns collected for conducting the experiments were maintained in plastic lined circular pools of 300 litres capacity. These pools were aerated continuously by compressed air through air diffusers. The pools were fitted with biological filters for oxidising the ammonia content of the water.

The water in the stock pools were partially changed. Sea water collected from the Arabian sea off Narakkal was used in the stocking tank for acclimation. Five prawns were kept in each stocking pool. For salinity experiments, the animals were acclimated for 2 to 3 days to the particular salinity in which the experiments were conducted.

The animals were fed *ad libitum* with compounded feed developed at Marine Prawn Hatchery Laboratory at Narakkal and uneaten food and faeces were removed everyday by siphoning.

c) Acclimation:

Healthy prawns were transferred from stocking pools to acclimation pools of the same size of stocking pools. Two or three prawns were kept in them at a time, for acclimation. The sea water collected from the Arabian sea was used here also. For low salinity experiments, the seawater diluted with freshwater (tap water) was used. For experiments in which the temperature was controlled, 2 to 3 animals were acclimatized in tanks of 150 litres capacity and the temperature was controlled by thermostatic relays. The experiments were conducted at temperatures to which the prawns were acclimated.

The acclimation tanks were provided with continuous aeration through air diffusers by compressed air, and dissolved oxygen concentration was kept close to air saturation. The water in the acclimation tanks were removed partially every day and fresh sea water of the same salinity was added. The animals were also fed *ad libitum* with compounded feed. The faeces and uneaten food were removed daily.

Before the start of the experiment, the animals were starved for 24 hours (Fromm,1963; Beamish,1964) and were acclimatized overnight to the respirometer. The temperatures selected for the present study were 27°C, 30°C and 33°C and the different salinities in which the experiments were conducted were 2, 8, 17.7, 23.7 and 32.4 ppt.

For studies on carbohydrate metabolism also, the animals were acclimated to the experimental salinity and were starved for 24 hours before the experiment.

II. Apparatus

The apparatus which was used for the present study consists of two units, an electronic counter and a transparant perspex respirometer.

a) Electronic counter:

In the inner hollow of the annular respirometer, twenty small photocells were fixed alongside vertically at 180° in two rows so as to face the light souce fixed just outside the periphery of respirometer. The interruption of the light beam by the animal was sensed by a transistor amplifier, which inturn actuate the electronic relay. The relay triggers the main contactor and thereby the counter. An interlocking system was arranged to avoid the obstruction of the same light by the animal consequently so that the second and following events will be recorded only if the second light is interrupted. The

The random activity counts recorded by the electronic counter, were counter checked by observing the movement of the animals visually.

b) <u>Respirometer:</u>

This is a modification of the annular respirometer of Fry and Hart(1948) used by Smit(1965), Kutty(1966) and Rao (1968). The top of the respirometer is covered by a transparent plastic sheet with two wells (height 6cm, diameter 4.5cm) opening above. Fitting these two wells are two plastic cups with a hole(diameter 5cm) at the bottom in each. These holes are only the places where open surface is available to the exterior. Diffusion of gases into the respirometer chamber was experimentally tested and it was found that the modifications provided an effective seal. The capacity of the respirometer is 3000ml. The dimensions of the respirometer are as follows: The outer and inner diameter of the annulus of the chamber are 26cm and the height is 8cm. The respiration chamber (except for the walls and cups of 1/16") is made of 1/8" plastic sheet.

c) <u>Recirculation system:</u>

For the acclimation as well as the experiments, a recirculation system was set up. It includes an overhead rectangular reservoir tank made of fibre glass which is placed at a height of 5 feet from the ground level. The water from

Fig. 1

Experimental set up

Fig. 2

Electrocautery apparatus

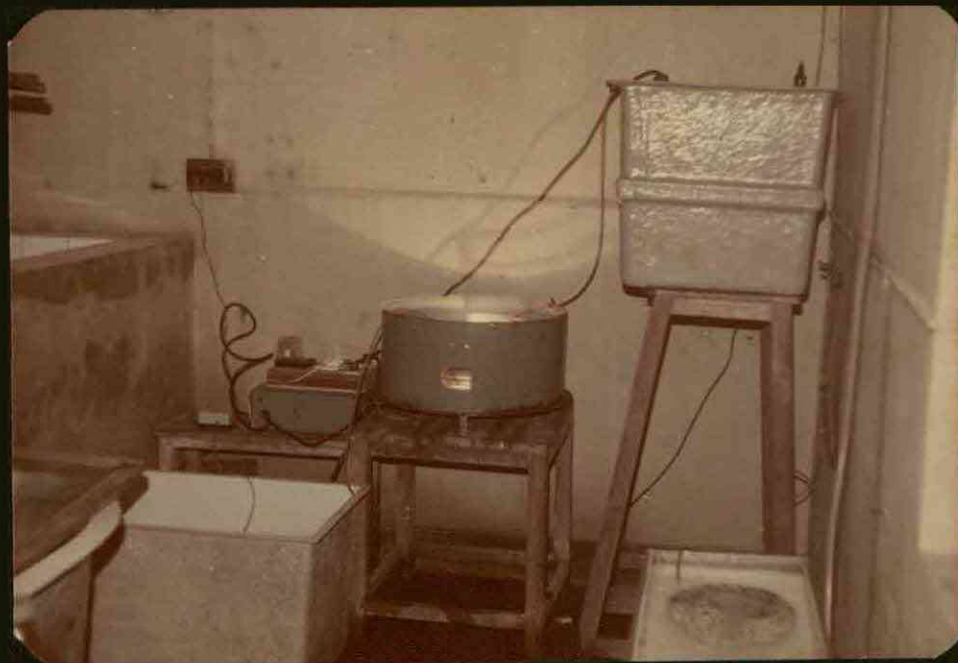


Fig. 3

Modified Fry's Respirometer - view from above

this tank was flushed through the respirometer to another rectangular fibre glass tank which has been kept at ground level. Both the tanks are of 200 litres capacity. The water from the ground level tank was pumped into the overhead tank using a 'Remi' pump. The pumping was regulated by a constant level device (Electronic control equipment company, Madurai). Compressed air was bubbled in both the tanks so as to maintain the oxygen concentration of the water near air saturation.

III. Experimental Design:

The following series of experiments were conducted.

1. The oxygen consumption, ammonia excretion, ammonia quotient and random activity was found out at the ambient water temperature(control) in full strength sea water in unablated, unilaterally ablated and bilaterally ablated males and females.

2. The effect of different temperatures on (1). The experiments were conducted in three different temperatures namely 27°C, 30°C & 33°C.

3. The effect of different salinities on (1). The experiments were conducted in 5 different salinities namely 2, 8, 17.7, 25.7 and 32.4 ppt.

4. Carbohydrate levels in hepatopancreas and muscle tissue of unablated, unilaterally ablated and bilaterally ablated female prawns.

IV. Experimental procedure:

a) Metabolic studies at normal temperature and salinity:

The experiments were conducted in the respirometer described above. The individual run of each experiment lasted for one hour.

The light inside the respirometer were switched on at least an hour prior to the starting of a days experiment and is kept on till the experiment is over. The experimental animals were introduced into the respirometer on the previous day and is kept overnight for acclimation in the recirculating system.

At the start of the experiment, initial samples were collected after the circulation of water through the respirometer was cut off. After an interval of one hour, the final samples were collected. In each sampling (initial, final of a single run) two water samples were collected for analysis of oxygen and ammonia. The size of the water sample was 30 ml. for oxygen and 10 ml. for ammonia(15 ml. collected first as rinse was discarded).

Immediately after sampling, the figure in the activity counter was recorded (initial and final). These random activity counts were counter checked by visually observing the movements of the prawns around the annulus of the respirometer.

After taking the final samples of the first run, the respirometer was flushed with air saturated water for a period of 15 minutes and after that the water circulation is cut off and the same procedure as given above was continued for sampling. This procedure was carried out for 6 runs.

For eyestalk ablation experiments, the animal acclimated overnight to the respirometer was taken and then the eyestalks were removed using an electrocautery apparatus. Electrocauterisation has been found to be effective in prawns since, it cuts the eyestalk and at the same time seals the wound instantly. This procedure, avoids loss of blood and assures 100% survival(Muthu and Laxminarayana 1979, 1981).

The concentration of oxygen and ammonia were determined in the sample acquired at the beginning and end of each run. The activity was calculated by the difference between the initial and final figures noted for each run.

The total length and wet weight of the prawns were taken after wiping carefully with blotting paper and the weight was recorded in a monopan balance.

b) Effect of different temperatures on the metabolism of eyestalk ablated and unablated *P. indicus*.

The experimental procedures were the same as mentioned above. The temperature of the overhead tank was controlled by thermostatic relays and the temperature of the water was closely monitored by checking with a glass thermometer. Ice was used to bring down the temperature whenever it was necessary.

c) Effect of salinity on the metabolism of eyestalk ablated and unablated *P. indicus*.

The experimental procedure was the same as described above and the salinity of the water in the overhead and ground tank was adjusted to the required salinity.

d) Effect of eyestalk ablation on Carbohydrate levels in hepatropancreas and muscle tissues:

Here 3 pools were taken and female prawns of same size of intermoult stage were introduced (5 in each pool) and the environmental parameters of the 3 pools are kept almost the same. The animals were kept for acclimation for 24 hours and during that period the prawns were starved.

At the start of the experiment, 5 prawns were ablated unilaterally and 5 prawns bilaterally, five prawns were kept as control(unablated).

Animals(one each from control, unilaterally ablated bilaterally ablated) were sacrificed after 24 hours, 48 hours, 72 hours, 96 hours and 120 hours and a piece of muscle tissue and hepatopancreas were taken and this was used for carbohydrate estimation.

V. Methods of water analysis:

a) Dissolved oxygen

The dissolved oxygen content of the water was estimated using the unmodified Winkler method(American Public Health Association,1965). All the analysis were done within an hour after sampling. The size of the sample used was 25 ml.

b) Ammonia

Phenol-hypochlorite spectro-photometric method given by Solarzano(1969) was followed with a slight modification. Ethanol was substituted by Methanol to avoid high blank optical density readings. The analysis was carried out immediately to reduce changes in ammonia level. The color developed was stable for more than 2 hours within which the optical density were recorded in an EC junior Spectrophotometer at 640mμ.

c) Salinity

Salinity was estimated using the standard Argento-titric method(Strickland and Parsons,1968).

VII. Estimation of Carbohydrates:

Carbohydrate levels in hepatopancreas and muscle were estimated by Phenol sulphuric acid method (Dubois *et al.*,1956).

VIII. Statistical analysis:

Mean values of 3 sets of values for the same experiment were taken and their standard deviation from the mean values were found out. The analysis of variance was done for the values obtained after unilateral and bilateral ablation. The original values were transformed using log transformation and the analysis was carried out using these values.

RESULTS

As explained in Materials and methods, the experiments were done in *P. indicus* at three temperatures (27, 30 and 33°C) and five different Salinities (2, 8, 17,7, 25.7 and 32.4 ppt). The data on Oxygen consumption, Ammonia excretion, Ammonia quotient and Random activity is presented in Table Nos. 1 - 18 and graphically plotted in Figures 4-21. The data on effect of ablation (unilateral and bilateral) on carbohydrate metabolism has been given in Table 19(a) and 19(b) and plotted in a graph (Fig.22(a) & (b).)

The data on statistical analysis is given in Tables 20-25.

1. Oxygen Consumption:

a) At 27 ± 0.5°C(Control) and full strength sea water:

At 27° ± 0.5°C and full strength sea water (32.4 ppt), the mean rate of oxygen consumption of the unablated female prawns were found to be 234.64 ml/kg/hr. In unilaterally ablated prawns, the value rose to 273.73 ml/kg/hr during the first hour and then it slowly dropped down and reached the normal value in about 5 hours and in bilaterally ablated
8 animals, the first hour value was very high(313.03 ml/kg/hr) and there was a sudden decrease in the second hour and then the decrease was gradual till it reached almost the normal

value(values obtained for unablated prawns) in 7 hours (Table 1 and Fig.4).

In males, the mean oxygen consumption rate in unablated prawns was 220.98 ml/kg/hr and in unilaterally ablated animals, immediately after ablation, the value was 287.37 ml/kg/hr and it came down slowly and reached the normal value around 5 hours and in bilaterally ablated animals, as in females, the first hour value was very high (308.87 ml/Kg/hr) and it almost showed a value near normal value after 7½ hours. (Table 2 and Fig.5).

Females are found to have a higher metabolic rate than males.

b) <u>At temperatures of 27°C, 30°C and 33°C</u>:

At 27°C, in females, the mean oxygen value for unablated ones was 233.65 ml/kg/hr and in unilaterally ablated animals, it rose to 270.6 ml/kg/hr and it slowly came down and stabilised around the normal value after 5 hours. In bilaterally ablated prawns, the first hour value was as high as 311.4 ml/kg/hr and slowly it decreased and reached the normal value in 7 hours time. (Table 3 and Fig.6).

In males, the rate of oxygen consumption after the first run was 263.5 ml/Kg/hr as compared to the mean oxygen value of 213.8 ml/kg/hr for unablated prawns and it reached the normal value and stablished after 5 hours. In bilaterally ablated prawns, the initial value was 305ml/kg/hr and it first rapidly decreased and then a slow decline was seen till it reached the value of unablated ones after 7¼ hours (Table 4 and Fig.7).

In females, at 30°C, the mean oxygen consumption rate was 249.61 ml/kg/hr in unablated prawns and in unilaterally ablated prawns it showed a decline from 333.27 ml/kg/hr to the normal value and it stablishd after 5 hours just above the normal value. A gradual decrease was found from 367.97 ml/kg/hr to almost normal value in about 7¼ hours in bilaterally ablated prawns (Table 5,and Fig.8).

At the same temperature, in males for unablated animals, the mean oxygen value was 275.27 ml/kg/hr and in unilaterally ablated animals, the initial value was 315.9 ml/kg/hr and it slowly decreased and reached the normal value around 4½ hours. In bilaterally ablated ones, the initial value was as high as 344 ml/kg/hr and reached the normal value around 5 hours and then it came down below the value obtained for unablated animals (Table 6 and Fig.9).

At 33°C, in females and males, the mean consumption rate in unablated ones were 308.23 and326.22 ml/kg/hr respectively and in females after unilateral ablation the value reached 405.6 ml/kg/hr and it reached the normal value after 5 hours and in bilaterally ablated prawns, normal value was reached after 7 hours with an initial value of 456 ml/kg/hr and the decline in values between the first and the last was clearly evident. (Rable 7 and Fig.10).

In unablated males, the consumption rate immediately after ablation was 355.75 ml/kg/hr and reached the normal value after 3½ hours and in bilaterally ablated prawns normal value was reached in 7 hours(Table 8 and Fig.11).

The mean oxygen consumption rate in unablated prawns increased with the increase in temperature. It was 233.65 ml/kg/hr and 213.8 ml/kg/hr at 27°C, 249.61 ml/kg/hr and 275.27 ml/kg/hr at 30°C and 308.23 ml/kg/hr ml/kg/hr and 326.22 ml/kg/hr at 33°C in females and males respectively. The rate of oxygen consumption was higher in females than in males.

c) <u>At salinities of 2, 8, 17.7, 25.7 and 32.4 ppt:</u>

In females, at 2 ppt salinity, the mean oxygen consumption rate for unablated prawns was 341.23 ml/kg/hr and in unilateral ones, immediately after ablation the value was 401.13 ml/kg/hr and slowly came down to normal value after 4¾ hours and in bilaterally ablated prawns, came to normal after 7 hours. (Table 9 and Fig.12).

In males, in unablated prawns, the mean rate was 297.54 ml/kg/hr and in unilaterally ablated animal after an initial rising upto 343.2 ml/kg/hr, reached normal stage after 3½ hours. In bilateral eyestalk removed prawns the initial rate of 401.96 ml/kg/hr declined slowly and then reached a normal value only after 7¼ hours (Table 10 and Fig. 13).

At 8 ppt, the mean rate of oxygen consumption the unablated females was 297.54 ml/kg/hr and 289.05 ml/kg/hr in males. After unilateral ablation, it increased to 343.2 ml/kg/hr and reached almost a steady level after 5 hours in females and in males it rose to 349.4 ml/kg/hr and then gradually decreased and reached the normal value after 5 hours.

After bilateral eyestalk ablation the rise was much in both females and males and in females it reached 401.96 ml/kg/hr and in males it was 393.2 ml/kg/hr and in both it reached almost a normal value after 7¼ hours(Table 11 & 12, and Fig. 14 & 15).

At 17.7 ppt, in females, in unablated prawns the mean oxygen consumption rate was 269.78 ml/kg/hr and in unilaterally ablated animals, initially it rose to 322.63 ml/kg/hr and gradually slowed down and reached the normal value after 4¾ hours. After bilateral ablation, the increase was more than that of unilateral and it went up to 367 ml/kg/hr and then gradually declined to reach the normal value after 7 hours (Table 13 and Fig.16).

In males, in unablated prawns, the mean oxygen consumption rate was 260.5 ml/kg/hr and in unilaterally ablated prawns, initially it was 298.53 ml/kg/hr and then gradually it came down and reached the normal value after 4½ hours and in bilaterally ablated ones, initially it rose to 353.73 ml/kg/hr and then it almost reached the normal level after 7¼ hours (Table 14, Fig. 17).

At 25.7 ppt, the mean oxygen consumption rate in unablated animals were 200.3 ml/kg/hr and 188.62 ml/kg/hr in females and males respectively. After unilateral ablation, the value rose to 251.8 ml/kg/hr and reached the normal value after 5½ hours in females and in males to 234.97 ml/kg/hr and reached almost a normal value after 5 hours. In females, after bilateral ablation, the initial rate of consumption was 291.6 ml/kg/hr and then fell down considerably and then it gradually reached the normal value after 7 hours and in males, it rose to 274.2 ml/kg/hr and then reached the normal value after 7 hours.(Table 15 & 16 and Fig. 18 & 19).

At 32.4 ppt, the mean oxygen consumption was 233.65 ml/kg/hr and 213.8 ml/kg/hr in unablated females and males respectively. After unilateral ablation, in females, it went up to 270.6 ml/kg/hr initially and then fell down to normal value after 6¾ hours and in males it went as high as 263.5 ml/kg/hr and reached the normal value after 4½ hours. The consumption rate rose to 311.4 ml/kg/hr and 305.0 ml/kg/hr and reached the normal value after 7 hours in bilaterally ablated females and males respectively. (Table 17 & 18 and Fig.20 & 21).

As salinity decreased from 32.4 ppt, mean oxygen consumption rate slowly decreased upto a certain level and a minimum value was obtained at 25.7 ppt. The value gradually rose as salinity decreased and it is the maximum at 2 ppt.

2. Ammonia Excretion:

a) At 27 ± 0.5°C and full strength sea water:

The mean ammonia values for unablated males were 8.505 ml/kg/hr and 7.262 ml/kg/hr in females. After unilateral ablation, the value increased to 9.57 ml/kg/hr and then decreased slowly and reachedalmost normal after 4 hours in females and rose to 8.275 ml/kg/hr and reached normal values after 5 hours in males. After bilateral ablation, the initial value was 11.013 ml/kg/hr and it reached normal after 7¼ hours and it increased to 9.966 ml/kg/hr and reached normal after 7¼ hours in females and males respectively (Table 1 & 2 and Fig.4 & 5).

b) <u>At temperatures of 27°C, 30°C and 33°C:</u>

At 27°C in unablated females, the mean rate of ammonia ecretion was 8.535 ml/kg/hr and it increased to 9.51 ml/kg/hr almost reached a steady level after 3 hours and increased to 10.99 ml/kg/hr and reached the normal value after 6 hours in unilaterally and bilaterally ablated animals respectively (Table 3 and Fig.6).

In males, the mean value for unablated animals was 7.23 ml/kg/hr and it rose to 8.26 ml/kg/hr after unilateral ablation and reached a steady level after 4 hours and it increased to 9.95 ml/kg/hr and reached the original value after 7 hours in bilaterally ablated ones. (Table 4, and Fig.7).

At 30°C, the mean ammonia excretion values for unablated prawns were 15.617 ml/kg/hr and 13.923 ml/kg/hr for females and males respectively and in females after unilateral ablation, it increased to 17.12 ml/kg/hr and dropped to original value after 2½ hours and after bilateral ablation, the initial value reached 18.45 ml/kg/hr and slowly declined to the normal value after 7¼ hours. (Table 5, and Fig.8).

In males, the values increased to 15.44 ml/kg/hr and 16.0 ml/kg/hr and reached a steady level after 2¼ hours and 5¾ hours in unilaterally and bilaterally ablated prawns respectively. (Table 6 and Fig.9).

At the temperature of 33°C, the mean ammonia value for unablated females was 23.865 ml/kg/hr and it rose to 26.05 ml/kg/hr and 28.89 ml/kg/hr and reached the normal value after 3½ hours and 7¼ hours in unilaterally and bilaterally ablated animals respectively(Table 7 and Fig.10).

In unablated males, the mean value of 21.976 ml/kg/hr was reached after 4 hours and 7 hours after rising to the initial values of 24.13 ml/kg/hr and 26.98 ml/kg/hr in unilaterally and bilaterally ablated animals respectively. (Table 8, Fig. 11).

It is found that the ammonia excretion rates increases with the increase in temperature and here again there is a difference in the excretion rates between females and males the former excretes more than the latter showing that the metabolic rate is more in females than in males.

c) <u>At salinities of 2 ppt, 8 ppt, 17.7 ppt, 25.7 ppt and 32.4 ppt.</u>

At 2 ppt, the mean ammonia excretion rate in unablated females were 36.072 ml/kg/hr and that for unablated males was 29.02 ml/kg/hr. In unilaterally ablated females the initial value rises upto 39.08 ml/kg/hr when compared to that of males' 30.91 ml/kg/hr and it reaches the normal value after 3 hours and 3¾ hours in females and males respectively(Table 9 and Fig.12)

In females, after bilateral ablation, the value increases to ~~a~~ 41.11 ml/kg/hr and returns to normal rate after 6¾ hours and in males, it goes upto a high value of 34.18 ml/kg/hr and returns to the normal value after 7¼ hours (Table 10 and Fig. 13).

At 8 ppt salinity, the mean excretion rate for unablated females was 29.02 ml/kg/hr and for males 26.986 ml/kg/hr.

In unilaterally ablated females, the initial excretion rate goes upto 30.91 ml/kg/hr and then comes to normal after 3¾ hours and after bilateral ablation, it rises to 34.18 ml/kg/hr and decreases gradually with time to reach the control value after 7¼ hours (Table 11, Fig.14).

In males, the value goes upto 28.34 ml/kg/hr and 31.95 ml/kg/hr and reaches a steady state after 5 hours and 7¼ hours in unilaterally and bilaterally ablated animals respectively (Table 12 and Fig.15).

At 17.7 ppt, the mean excretion rate was 21.802 ml/kg/hr and 19.823 ml/kg/hr in unablated females and males respectively.

After unilateral ablation, the value rises to 24.05 ml/kg/hr and 21.34 ml/kg/hr and reaches a steady level after 3 hours and 2½ hours in females and males respectively.

The values reach 26.94 ml/kg/hr and 23.93 ml/kg/hr and then decreases gradually to become normal after 7¼ hours both in females and males respectively after bilateral ablation (Table 13 & 14 and Fig. 16 & 17).

At 25.7 ppt, in unablated females, the mean ammonia excretion value is 14.702 ml/kg/hr and after unilateral ablation it increases to 16.89 ml/kg/hr and reaches control values after 4½ hours and in bilaterally ablated females, the control values are reached after 7¼ hours and the initial rise after ablation touched 19.05 ml/kg/hr.(Tables 15, and fig.18).

In males, after unilateral ablation, the value rises to 16.14 ml/kg/hr and reaches the normal value for unablated prawns (13.972 ml/kg/hr) in 3 hours. After bilateral ablation, the value increases suddenly to 17.98 ml/kg/hr from the control value and reaches it after 7 hours (Table 16 and Fig.19).

At 32.4 ppt, the mean NH_3 excretion values for unablated prawns were 8.535 ml/kg/hr and 7.23 ml/kg/hr respectively for females and males.

After unilateral ablation, it rises to 9.51 ml/kg/hr and reaches a steady state after 3¾ hours in females and in 3¾ hours after initially reaching 8.26 ml/kg/hr in males.

In females, after bilateral ablation, the normalcy is reached after 5¾ hours after rising initially to 10.99 ml/kg/hr and in males, it initially goes upto 9.95 ml/kg/hr and then decreases gradually to the control values after 7 hours. (Table 17 & 18 and Fig.20 & 21).

In general, the excretion rate of ammonia is high at 2 ppt and slowly decreases with increasing salinity and it is the lowest at32.4 ppt. Here also, females excrete more ammonia than males in a particular salinity.

3. <u>Ammonia quotient</u>

a) <u>At 27 ± 5°C and full strength sea water:</u>

In females, the mean ammonia quotient for unablated prawns is 0.0362. After unilateral ablation the value falls down to 0.0347 and then it reaches the normal value after 5½ hours. In bilaterally ablated ones, the value falls down initially to 0.0352 and then it reaches the normal value gradually after 7¼ hours. (Table 1 and Fig.4).

In males, the mean ammonia quotient was found to be 0.0329 and it decreased to 0.0288 initially after unilateral ablation and reached the control value only after 7¼ hours. In bilaterally ablated animals, the initial value was 0.0323 and then it suddenly rose above the control value to 0.0336 and then finally dropped down below control value after 7¼ hours. (Table 2 and Fig. 5).

Table - 1

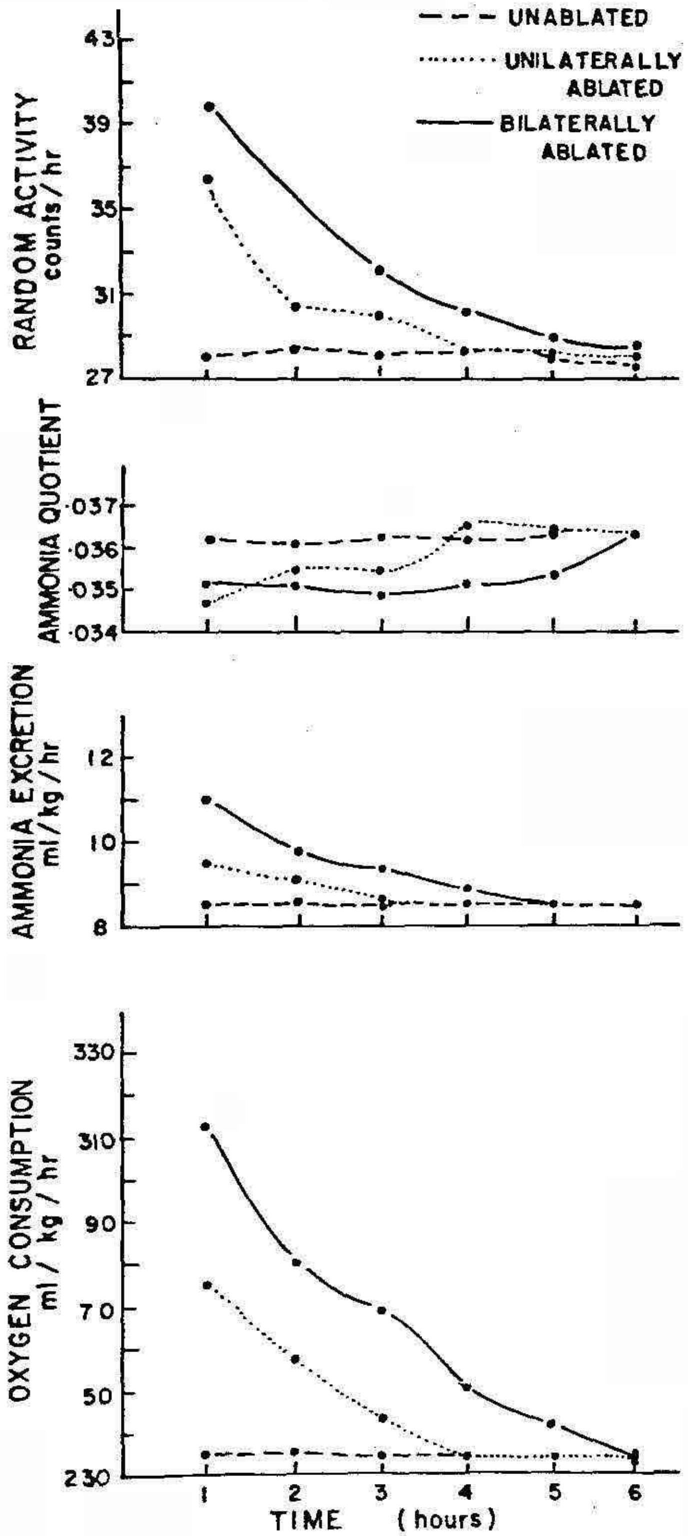
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27$\pm$0.5°C and full strength sea water (32.4 ppt). This is the summary of the results obtained from 3 unablated (Mean weight 18.17 $\pm$ 0.85), 3 unilaterally ablated (Mean weight 17.17 $\pm$ 0.24) and 3 bilaterally ablated (Mean weight 18 $\pm$ 0.82) prawns of the size group 120-140mm

TABLE - 1

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/kg/hr.	Ammonia Quotient	Random Activity counts/hr.	
1	235.2 ± 2.57	8.504 ± 0.017	0.0362 ± 0.0004	28.0	Unablated
2	235.23± 1.72	8.503 ± 0.015	0.0361 ± 0.002	28.4	
3	234.4 ± 1.63	8.505 ± 0.012	0.0363 ± 0.0002	28.2	
4	234.67± 1.39	8.506 ± 0.012	0.0362 ± 0.0002	28.4	
5	234.17± 0.47	8.505 ± 0.013	0.0363 ± 0	28.0	
6	234.17± 1.47	8.506 ± 0.013	0.0363 ± 0.0002	27.6	
1	275.73± 2.00	9.57 ± 0.090	0.0347 ± 0.0005	36.5	Unilaterally ablated
2	256.8 ± 0.33	9.116 ± 0.0033	0.0355 ± 0	30.4	
3	243.07± 1.41	8.636 ± 0.0044	0.0355 ± 0.0002	30.1	
4	234.07± 0.75	8.532 ± 0.0084	0.0365 ± 0	28.4	
5	234.27± 1.47	8.520 ± 0.0083	0.0364 ± 0.002	28.2	
6	233.53± 0.81	8.511 ± 0.0063	0.0364 ± 0.0001	28.2	
1	313.03± 0.834	11.013 ± 0.0129	0.0352 ± 0	40.1	Bilaterally ablated
2	279.93± 1.482	9.85 ± 0.0029	0.0352 ± 0.0002	31.2	
3	269.47± 1.112	9.417 ± 0.0104	0.0349 ± 0.0002	32.0	
4	251.33± 0.819	8.859 ± 0.0057	0.0352 ± 0.0001	30.2	
5	242.43± 0.685	8.568 ± 0.0479	0.0353 ± 0.0002	28.9	
6	2[illegible]4.2 ± 0.49	8.518 ± 0.0008	0.0364 ± 0	28.4	

Fig. 4

Oxygen Consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 ± 0.5°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
43
39
35
31
27
AMMONIA QUOTIENT
·037
·036
·035
·034
AMMONIA EXCRETION ml / kg / hr
12
10
8
OXYGEN CONSUMPTION ml / kg / hr
330
310
90
70
50
230
1
2
3
4
5
6
TIME (hours)

Table - 2

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 ± 0.5°C and full strength sea water (32.4 ppt). This is the summary of the results obtained from 3 unablated (Mean weight 15.33 ± 0.47), 3 unilaterally ablated (Mean weight 16.67 ± 0.47) and 3 bilaterally ablated (Mean weight 17.83 ± 0.85) prawns of the size group 120-140mm.

TABLE - 2

Runs	Oxygen Consumption ml/Kg/hr	Ammonia Excretion ml/kg/hr	Ammonia Quotient	Random Activity counts/hr.	
1	220.27 ± 8.868	7.265 ± 0.0086	0.003 ± 0.0013	33.0	
2	220.93 ± 8.99	7.259 ± 0.0037	0.0329 ± 0.0013	33.1	
3	220.76 ± 8.09	7.261 ± 0.0072	0.0329 ± 0.0012	32.6	
4	220.4 ± 8.56	7.263 ± 0.0070	0.0330 ± 0.0013	32.4	Unablated
5	221.6 ± 7.35	7.263 ± 0.0078	0.0328 ± 0.0011	32.8	
6	221.33 ± 6.66	7.262 ± 0.0075	0.0328 ± 0.0010	33.6	
1	287.37 ± 7.15	8.275 ± 0.0135	0.0288 ± 0.0007	40.8	
2	256.77 ± 6.90	7.817 ± 0.017	0.0305 ± 0.0008	35.6	
3	248.53 ± 7.57	7.273 ± 0.0007	0.0293 ± 0.0009	33.2	
4	225.77 ± 5.30	7.262 ± 0.0002	0.0322 ± 0.0007	33.0	Unilaterally ablated
5	219.2 ± 5.61	7.261 ± 0.0003	0.0324 ± 0.0015	33.6	
6	218.57 ± 7.49	7.261 ± 0.0003	0.0328 ± 0.0016	33.0	
1	308.87 ± 2.75	9.966 ± 0.0059	0.0323 ± 0.0033	47.0	
2	267.73 ± 5.56	8.996 ± 0.0139	0.0336 ± 0.0008	41.4	
3	256.87 ± 0.41	8.417 ± 0.0045	0.0327 ± 0.0001	39.8	
4	242.47 ± 1.51	8.077 ± 0.0119	0.0333 ± 0.0002	38.2	Bilaterally ablated
5	228.0 ± 0.43	7.576 ± 0.0077	0.0333 ± 0	36.1	
6	224.07 ± 2.14	7.264 ± 0.0042	0.0325 ± 0.0003	33.4	

Fig. 5

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) <u>Penaeus indicus</u> males acclimated to and tested at 27$\pm$0.5°C and 32.4ppt.

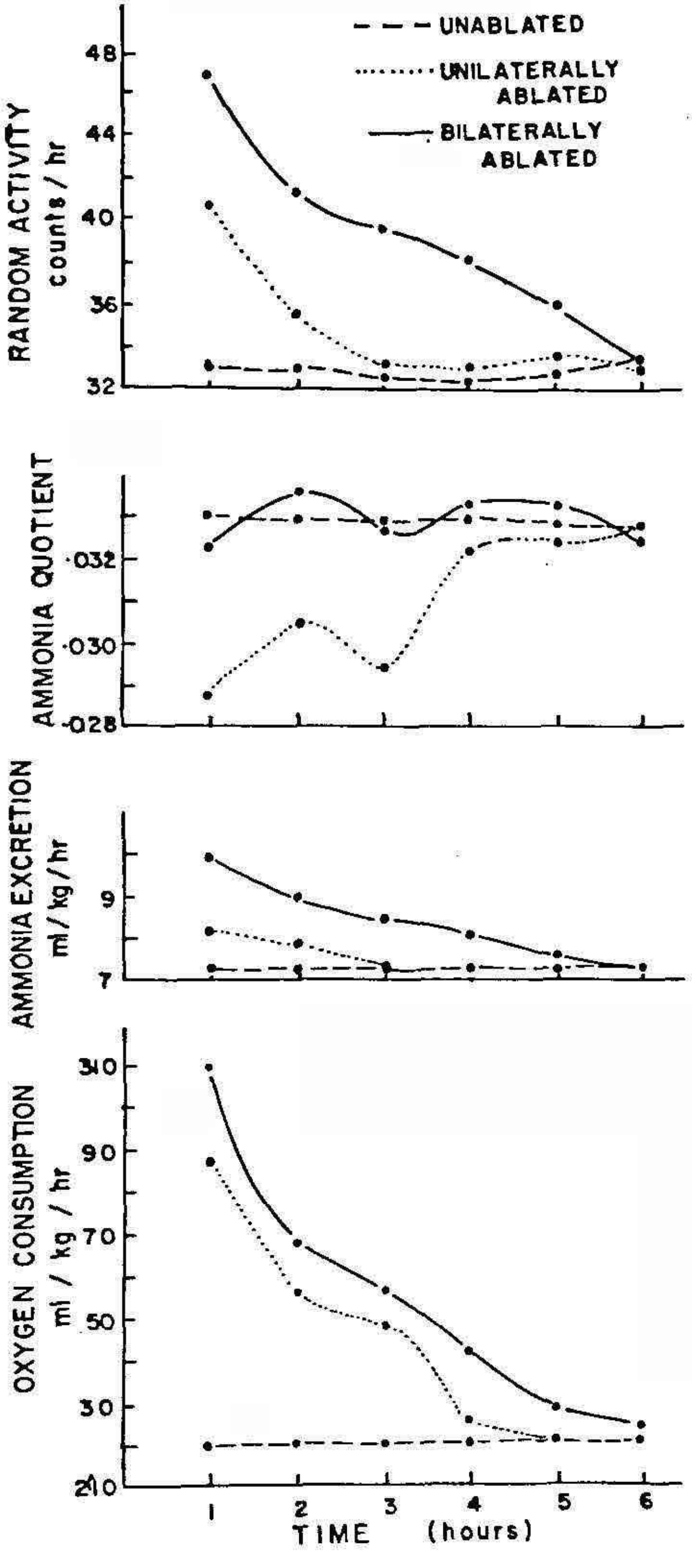

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
48
44
40
36
32
AMMONIA QUOTIENT
·032
·030
·028
AMMONIA EXCRETION ml / kg / hr
9
7
OXYGEN CONSUMPTION ml / kg / hr
110
90
70
50
30
10
1
2
3
4
5
6
TIME (hours)

Table - 3

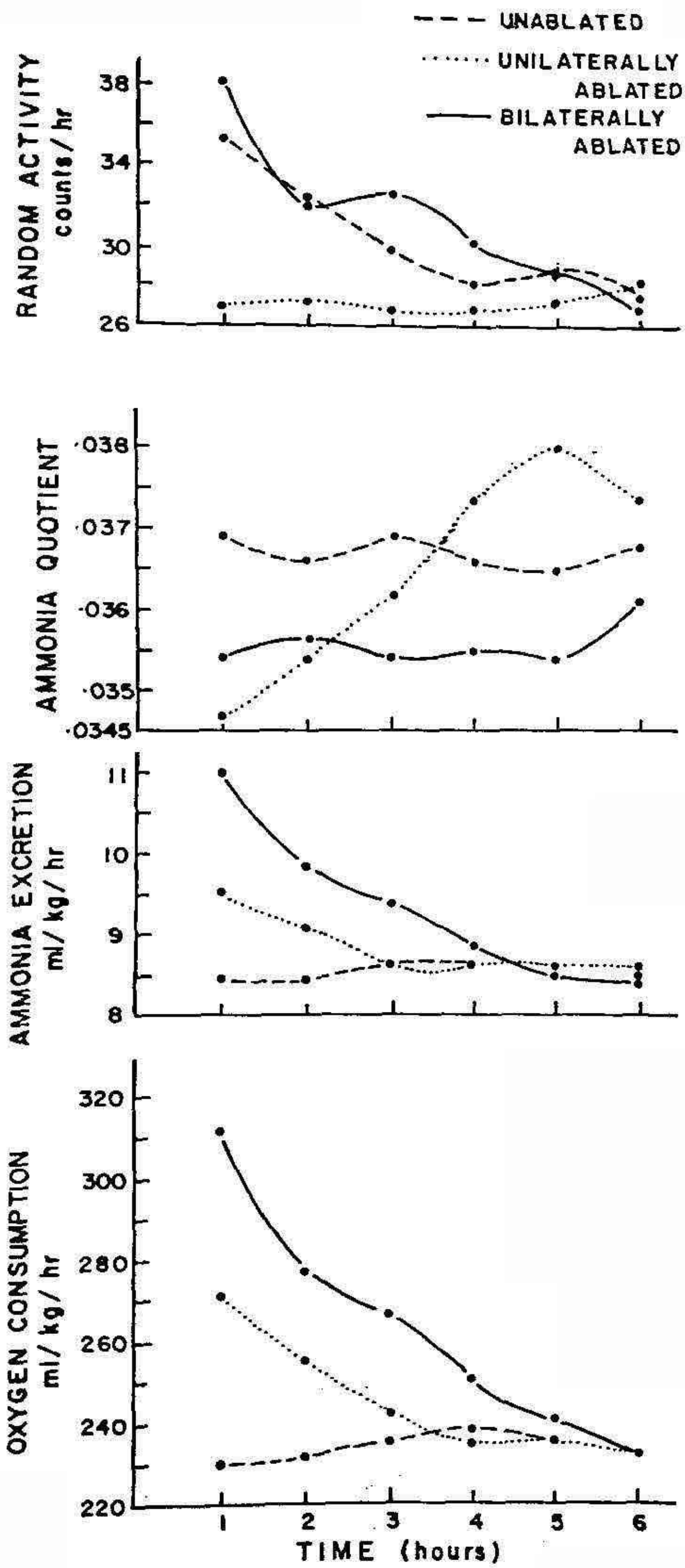
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 17.83 ±0.85), 3 unilaterally ablated (Mean weight 18.17 ± 0.85) and 3 bilaterally ablated (Mean weight 18 ± 0.82) prawns of the size group 120-140mm.

<u>TABLE - 3</u>

Runs	02 Consumption ml/Kg/hr	Ammonia Excretion ml/Kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	229.8 ± 17.63	8.46 ± 0.2123	0.0369 ± 0.0021	27.0	
2	231.5 ± 16.67	8.46 ± 0.2123	0.0366 ± 0.0017	27.3	
3	235.2 ± 17.98	8.64 ± 0.2017	0.0369 ± 0.0031	26.8	
4	238.3 ± 24.45	8.65 ± 0.2379	0.0366 ± 0.0031	26.8	Unablated
5	234.8 ± 21.15	8.50 ± 0.1621	0.0365 ± 0.0030	27.2	
6	232.3 ± 16.17	8.50 ± 0.1621	0.0368 ± 0.0022	28.2	
1	270.6 ± 25.01	9.51 ± 0.741	0.0347 ± 0.0041	35.2	
2	255.2 ± 24.34	9.11 ± 0.9125	0.0354 ± 0.0036	32.2	
3	241.7 ± 30.91	8.63 ± 0.1717	0.0352 ± 0.0041	29.8	
4	234.8 ± 21.15	8.62 ± 0.1551	0.0374 ± 0.0035	28.2	Unilatera-lly ablated
5	234.8 ± 21.15	8.62 ± 0.1551	0.038 ± 0.0034	28.8	
6	232.3 ± 16.17	8.58 ± 0.4535	0.0374 ± 0.0034	27.6	
1	311.4 ± 18.17	10.99 ± 0.3456	0.0354 ± 0.0011	38.0	
2	276.5 ± 14.46	9.84 ± 0.2951	0.0356 ± 0.0009	32.0	
3	266.2 ± 14.09	9.4 ± 0.1920	0.0354 ± 0.0012	32.6	Bilaterally ablated
4	250.2 ± 13.40	8.86 ± 0.2344	0.0355 ± 0.0009	30.2	
5	239.9 ± 12.83	8.47 ± 0.2733	0.0354 ± 0.0008	28.8	
6	232.3 ± 16.17	8.38 ± 0.3799	0.0361 ± 0.0015	27.0	

Fig. 6

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
38
34
30
26
AMMONIA QUOTIENT
·038
·037
·036
·035
·0345
AMMONIA EXCRETION ml/kg/hr
11
10
9
8
OXYGEN CONSUMPTION ml/kg/hr
320
300
280
260
240
220
1
2
3
4
5
6
TIME (hours)

Table-4

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 16 ± 0.82), 3 unilaterally ablated (Mean weight 15.33 ± 0.47) and 3 bilaterally ablated (Mean weight 15.5 ± 0.41) prawns of the size group 120-140 mm.

TABLE - 4

Runs	Oxygen Consumption ml/Kg/hr	Ammonia Excretion ml/Kg./hr.	Ammonia Quotient	Randum Activity counts/hr.	
1	214.3 ± 11.97	7.20 ± 0.4224	0.0336 ± 0.0004	32.0	
2	213.5 ± 3.40	7.25 ± 0.4930	0.034 ± 0.0018	35.8	
3	213.1 ± 8.46	7.25 ± 0.4930	0.0341 ± 0.0022	34.3	
4	216.4 ± 4.79	7.25 ± 0.4930	0.0335 ± 0.0016	34.5	Unablated
5	211.6 ± 4.18	7.25 ± 0.4930	0.0342 ± 0.0019	34.2	
6	213.9 ± 5.70	7.18 ± 0.3894	0.0336 ± 0.0017	35.5	
1	263.5 ± 14.84	8.26 ± 0.0919	0.0314 ± 0.0014	40.0	
2	244.4 ± 13.82	7.8 ± 0	0.0320 ± 0.0019	36.0	
3	235.4 ± 14.40	7.29 ± 0.0141	0.0311 ± 0.0019	35.0	Unilaterally ablated
4	213.87 ± 5.70	7.29 ± 0.0141	0.0341 ± 0.0010	34.3	
5	213.87 ± 5.7	7.29 ± 0.0141	0.0341 ± 0.0010	34.5	
6	213.87 ± 5.7	7.27 ± 0.0141	0.0008 ± 0.0008	34.0	
1	305.0 ± 10.86	9.95 ± 0.1396	0.0326 ± 0.0008	45	
2	266.9 ± 7.62	8.9 ± 0.2368	0.0334 ± 0.0003	42.8	
3	254.3 ± 7.09	8.39 ± 0.2205	0.033 ± 0.0004	41.0	Bilaterally ablated.
4	234.2 ± 6.58	8.06 ± 0.2123	0.0344 ± 0	38.5	
5	223.0 ± 6.56	7.55 ± 0.2000	0.0338 ± 0.0005	36.0	
6	213.87 ± 5.7	7.19 ± 0.1021	0.0337 ± 0.0011	34.6	

Fig. 7

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27°C and 32.4 ppt.

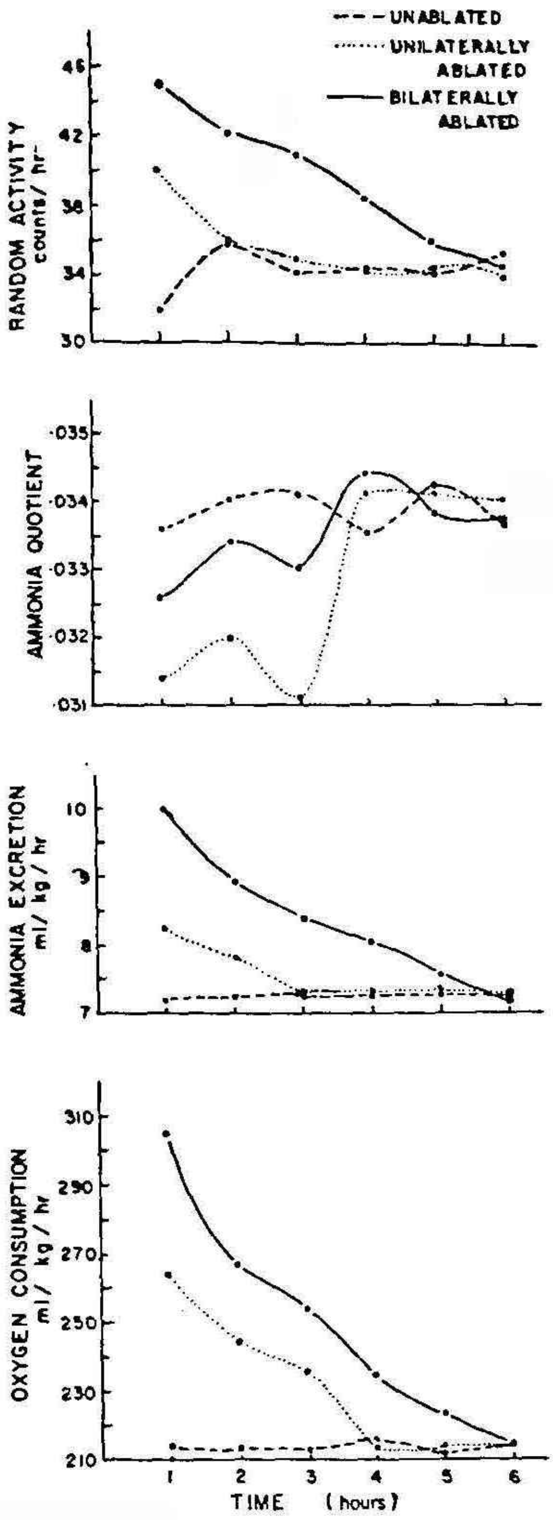

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/ hr
46
42
38
34
30
AMMONIA QUOTIENT
·035
·034
·033
·032
·031
AMMONIA EXCRETION ml/ kg / hr
10
9
8
7
OXYGEN CONSUMPTION ml/ kg / hr
310
290
270
250
230
210
1
2
3
4
5
6
TIME (hours)

Table - 5

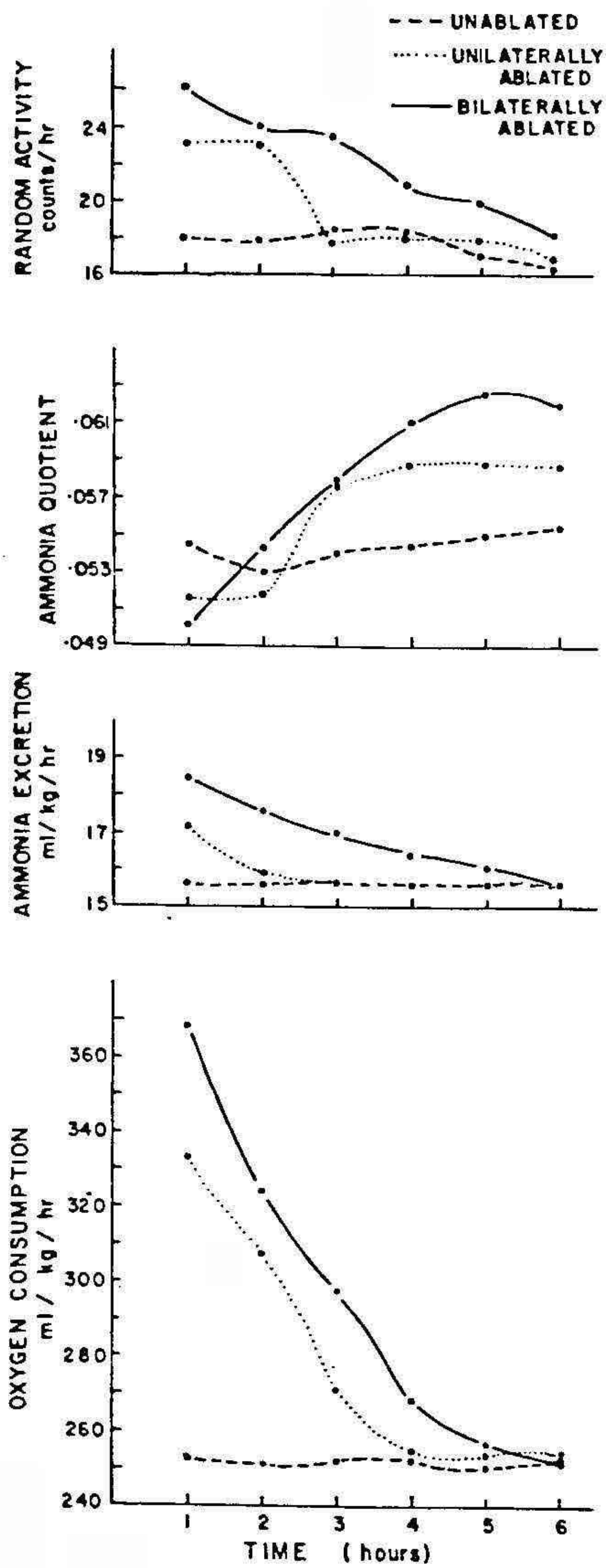
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated, and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 30°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 16.17 ± 0.85), 3 unilaterally ablated (Mean weight 17.17 ± 0.24) and 3 bilaterally ablated (Mean weight 18.5 ± 0.41) prawns of the size group 120-140 mm.

TABLE - 5

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/Kg/hr.	Ammonia Quotient	Randum Activity Counts/hr.	
1	252.23 ± 12.47	15.62 ± 0.3611	0.0543 ± 0.0008	18.0	
2	251.2 ± 13.42	15.62 ± 0.3611	0.0531 ± 0.0021	18.0	
3	251.9 ± 17.64	15.62 ± 0.3611	0.0540 ± 0.0007	18.6	
4	250.3 ± 17.64	15.61 ± 0.4793	0.0545 ± 0.0024	18.5	Unablated
5	250.3 ± 15.33	15.61 ± 0.4793	0.0550 ± 0.0023	17.2	
6	241.7 ± 13.49	15.62 ± 0.4713	0.0554 ± 0.0009	16.6	
1	333.27 ± 20.85	17.12 ± 0.2310	0.0516 ± 0.0038	23.0	
2	306.97 ± 11.32	15.91 ± 0.2168	0.0518 ± 0.0009	23.0	
3	270.77 ± 3.88	15.6 ± 0.2121	0.0576 ± 0	18.0	Unilaterally ablated
4	254.3 ± 1.86	15.6 ± 0.2121	0.0589 ± 0	18.2	
5	259.3 ± 1.86	15.6 ± 0.2121	0.0589 ± 0	18.0	
6	253.7 ± 1.06	15.6 ± 0.2121	0.0586 ± 0.007	17.0	
1	367.97 ± 8.12	18.45 ± 0.2024	0.0502 ± 0.009	26.0	
2	323.97 ± 7.58	17.60 ± 0.2719	0.0543 ± 0.0014	24.0	
3	296.97 ± 6.26	16.99 ± 0.1944	0.0579 ± 0.0018	23.6	
4	268.33 ± 7.75	16.43 ± 0.2155	0.0611 ± 0.0015	21.0	Bilaterally ablated
5	256.43 ± 8.53	16.06 ± 0.2514	0.0627 ± 0.0012	20.2	
6	253.1 ± 9.97	15.63 ± 0.1731	0.0619 ± 0.0021	18.5	

Fig. 8

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus *indicus* females acclimated to and tested at 30°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
16
20
24
AMMONIA QUOTIENT
·049
·053
·057
·061
AMMONIA EXCRETION ml/kg/hr
15
17
19
OXYGEN CONSUMPTION ml/kg/hr
240
260
280
300
320
340
360
1
2
3
4
5
6
TIME (hours)

Table - 6

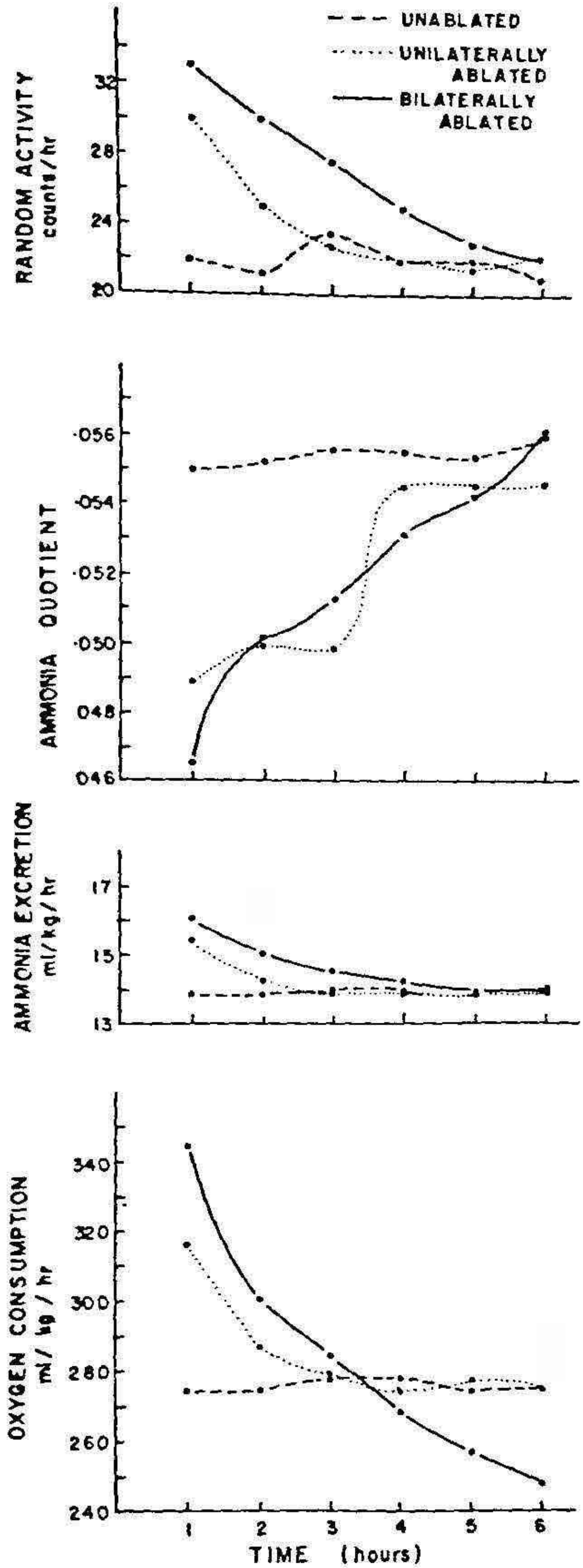
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) <u>Penaeus indicus</u> males acclimated to and tested at 30°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 14.67 $\pm$ 0.62), 3 unilaterally ablated (Mean weight 15.5 $\pm$ 0.41) and 3 bilaterally ablated (Mean weight 17.5 $\pm$ 0.41) prawns of the size group 120-140 mm.

TABLE - 6

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/kg./hr.	Ammonia Quotient	Randum Activity Counts/hr.	
1	274.3 ± 12.13	13.85 ± 0.5837	0.0550 ± 0.0005	22.0	
2	274.3 ± 12.13	13.85 ± 0.5837	0.0552 ± 0.0006	21.2	
3	277.3 ± 12.47	13.97 ± 0.4371	0.0556 ± 0.0022	23.5	
4	277.3 ± 12.47	13.96 ± 0.4368	0.0555 ± 0.0022	22.0	Unablated
5	274.2 ± 11.95	13.84 ± 0.5815	0.0554 ± 0.0010	22.0	
6	274.2 ± 11.95	14.07 ± 0.05809	0.0559 ± 0.0010	21.0	
1	315.9 ± 15.15	15.44 ± 0.2310	0.0489 ± 0.0018	30.0	
2	286.6 ± 14.00	14.26 ± 0.0369	0.0499 ± 0.0025	25.0	
3	278.5 ± 11.01	13.86 ± 0.0374	0.0498 ± 0.0019	22.8	
4	274.3 ± 12.13	13.86 ± 0.0374	0.0545 ± 0.0004	22.0	Unilaterally ablated
5	277.3 ± 12.47	13.86 ± 0.0374	0.0545 ± 0.0004	21.5	
6	274.2 ± 11.95	13.86 ± 0.0374	0.0546 ± 0.002	22.2	
1	344.0 ± 10.23	16.0 ± 0.0779	0.0465 ± 0.0011	33.00	
2	299.6 ± 7.26	15.01 ± 0.1982	0.0501 ± 0.0010	30.0	
3	283.7 ± 6.87	14.50 ± 0.0450	0.0512 ± 0.0011	27.6	
4	267. ± 6.53	14.21 ± 0.0340	0.0531 ± 0.0012	25.0	
5	256.6 ± 6.55	13.91 ± 0.2363	0.0542 ± 0.0014	23.0	
6	247.8 ± 8.31	13.89 ± 0.1388	0.0561 ± 0.0016	22.3	

Fig. 9

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 30°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
20
24
28
32
AMMONIA QUOTIENT
046
048
·050
·052
·054
·056
AMMONIA EXCRETION ml/kg/hr
13
15
17
OXYGEN CONSUMPTION ml/kg/hr
240
260
280
300
320
340
1
2
3
4
5
6
TIME (hours)

Table - 7

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus indicus females acclimated to and tested at 33°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 17.83 ± 0.85), 3 unilaterally ablated (Mean weight 18.17 ± 0.85), and 3 bilaterally ablated (Mean weight 18 ± 0.82) prawns of the size group 120-140mm.

TABLE - 7

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/kg/hr.	Ammonia Quotient	Randum Activity Counts/hr.	
1	308.0 ± 29.46	23.83 ± 0.4960	0.078 ± 0.0063	14.5	
2	306.2 ± 28.97	23.83 ± 0.4960	0.0781 ± 0.0058	14.0	
3	310.2 ± 29.36	23.73 ± 0.5313	0.0771 ± 0.0065	13.5	
4	307.3 ± 29.24	23.88 ± 0.5214	0.0788 ± 0.0062	14.2	Unablated
5	308.9 ± 35.35	23.96 ± 0.4999	0.0784 ± 0.0078	14.3	
6	308.8 ± 35.33	23.96 ± 0.4999	0.0785 ± 0.0078	14.0	
1	405.6 ± 26.8	26.05 ± 0.0660	0.0645 ± 0.0042	24.0	
2	360.8 ± 20.02	24.24 ± 0.2175	0.0674 ± 0.0031	22.0	
3	320.7 ± 6.14	23.85 ± 0.1408	0.0725 ± 0.0035	21.0	Unilaterally ablated
4	310.6 ± 12.49	23.86 ± 0.1408	0.0769 ± 0.0026	20.0	
5	308.7 ± 13.48	23.86 ± 0.1408	0.0774 ± 0.0029	14.0	
6	308.4 ± 13.10	23.86 ± 0.1408	0.0775 ± 0.0028	15.2	
1	456 ± 26.22	28.89 ± 0.1347	0.0636 ± 0.0033	36.0	
2	414.7 ± 23.77	26.97 ± 0.1780	0.0652 ± 0.0033	28.0	
3	368.2 ± 21.69	26.00 ± 0	0.0708 ± 0.0041	24.0	Bilaterally ablated
4	340.3 ± 17.69	24.93 ± 0.2490	0.0734 ± 0.0031	18.0	
5	326.5 ± 21.18	24.18 ± 0.2165	0.0743 ± 0.0042	16.0	
6	307.7 ± 24.44	23.91 ± 0.0974	0.0782 ± 0.0063	14.5	

Fig. 10

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablted and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 30°C and 32.4 ppt.

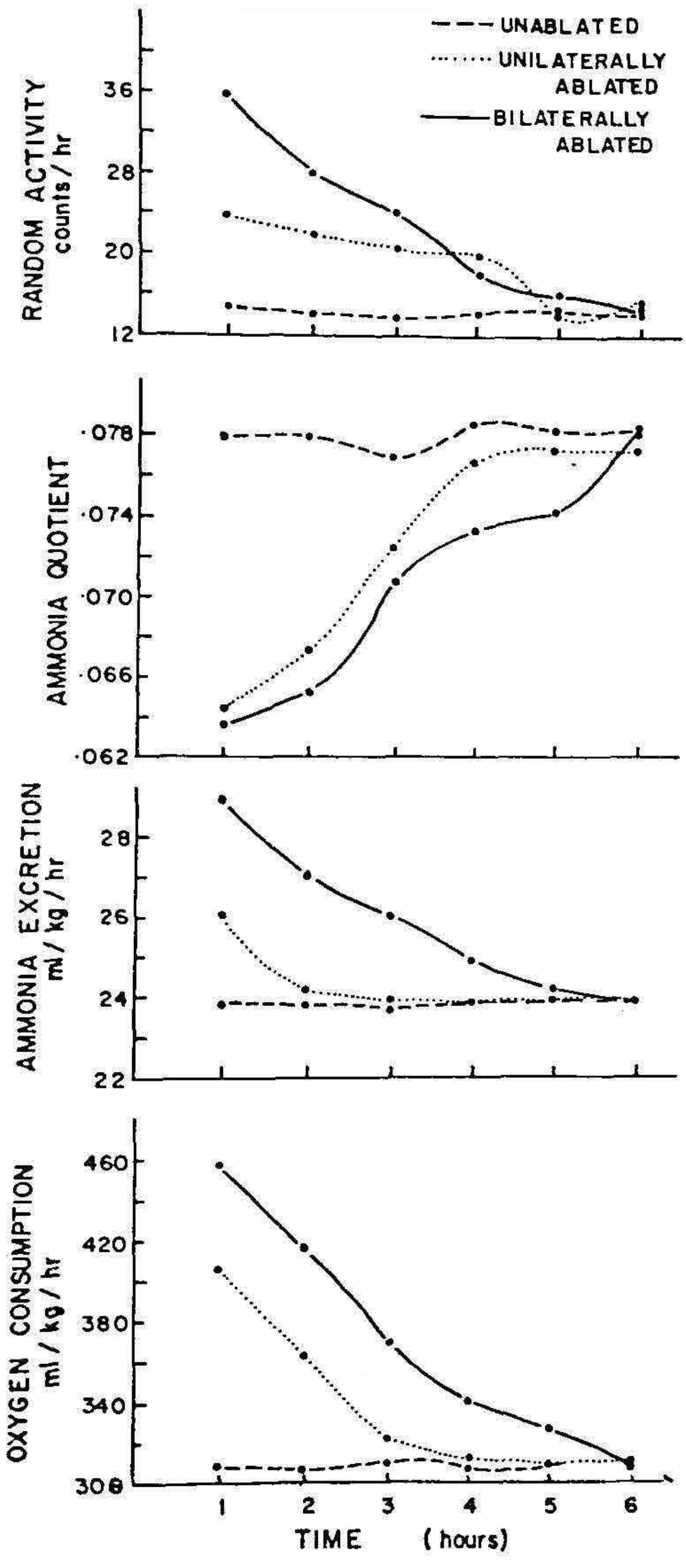

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
36
28
20
12
AMMONIA QUOTIENT
·078
·074
·070
·066
·062
AMMONIA EXCRETION ml / kg / hr
28
26
24
22
OXYGEN CONSUMPTION ml / kg / hr
460
420
380
340
308
1
2
3
4
5
6
TIME (hours)

Table 8

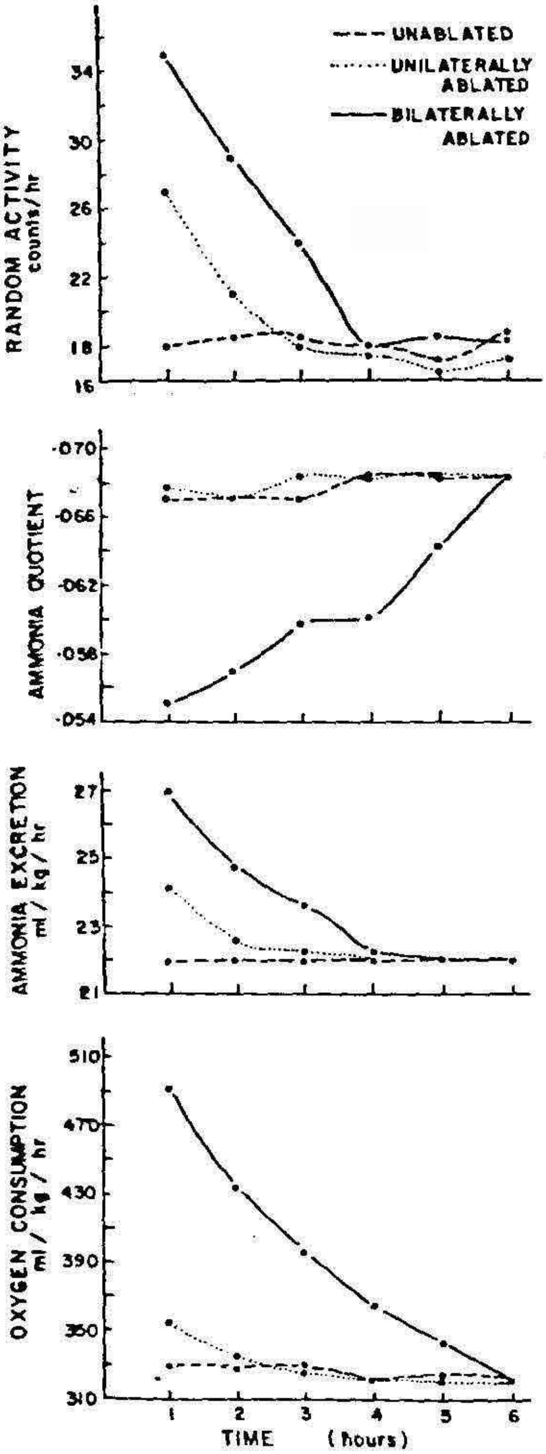
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated, and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 33°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 15 ± 0.82), 3 unilaterally ablated (Mean weight 16.67 ± 0.47) and 3 bilaterally ablated (Mean weight 15.17 ± 0.85) prawns of the size group 120-140 mm.

TABLE - 8

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/kg/hr.	Ammonia Quotient	Randam Activity Counts/hr.	
1	329.6 ± 28.42	21.98 ± 0.3746	0.0671 ± 0.0047	18.0	
2	329.3 ± 25.25	21.98 ± 0.3746	0.0671 ± 0.0042	18.5	
3	329.0 ± 22.94	21.97 ± 0.3665	0.0670 ± 0.0040	18.5	Unablated
4	322.0 ± 25.42	21.97 ± 0.3665	0.0686 ± 0.0044	18.0	
5	324.0 ± 27.99	21.98 ± 0.3065	0.0683 ± 0.0050	17.2	
1	355.75± 12.37	24.13 ± 0.1744	0.0677 ± 0.0015	27.0	
2	335.8 ± 7.17	22.57 ± 0.1273	0.0672 ± 0.0011	21.0	
3	325.8 ± 11.02	22.26 ± 0.1179	0.0684 ± 0.0020	18.0	
4	322.23± 9.4	22.00 ± 0.3087	0.0683 ± 0.0009	17.5	Unilaterally ablated
5	321.00± 4.81	22.00 ± 0.3087	0.0685 ± 0.0002	16.5	
6	321.23 ± 7.75	22.00 ± 0.3087	0.0685 ± 0.0006	17.2	
1	492.87 ±32.72	26.98 ± 0.2243	0.0550 ± 0.0030	35.0	
2	435.13± 31.63	24.70 ± 0.2834	0.0570 ± 0.0034	29.0	
3	396.2 ± 26.42	23.60 ± 0.1223	0.0598 ± 0.0036	24.0	
4	365.2 ± 24.21	22.25 ± 0.3035	0.0611 ± 0.0031	18.0	Bilaterally ablated
5	343.5 ± 19.72	22.01 ± 0.2027	0.6642 ± 0.0030	18.5	
6	321.3 ± 21.65	21.90 ± 0.2923	0.0684 ± 0.0036	18.5	

Fig. 11

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 30°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
34
30
26
22
18
16
AMMONIA QUOTIENT
·070
·066
·062
·058
·054
AMMONIA EXCRETION ml / kg / hr
27
25
23
21
OXYGEN CONSUMPTION ml / kg / hr
510
470
430
390
350
310
1 2 3 4 5 6
TIME (hours)

Table - 9

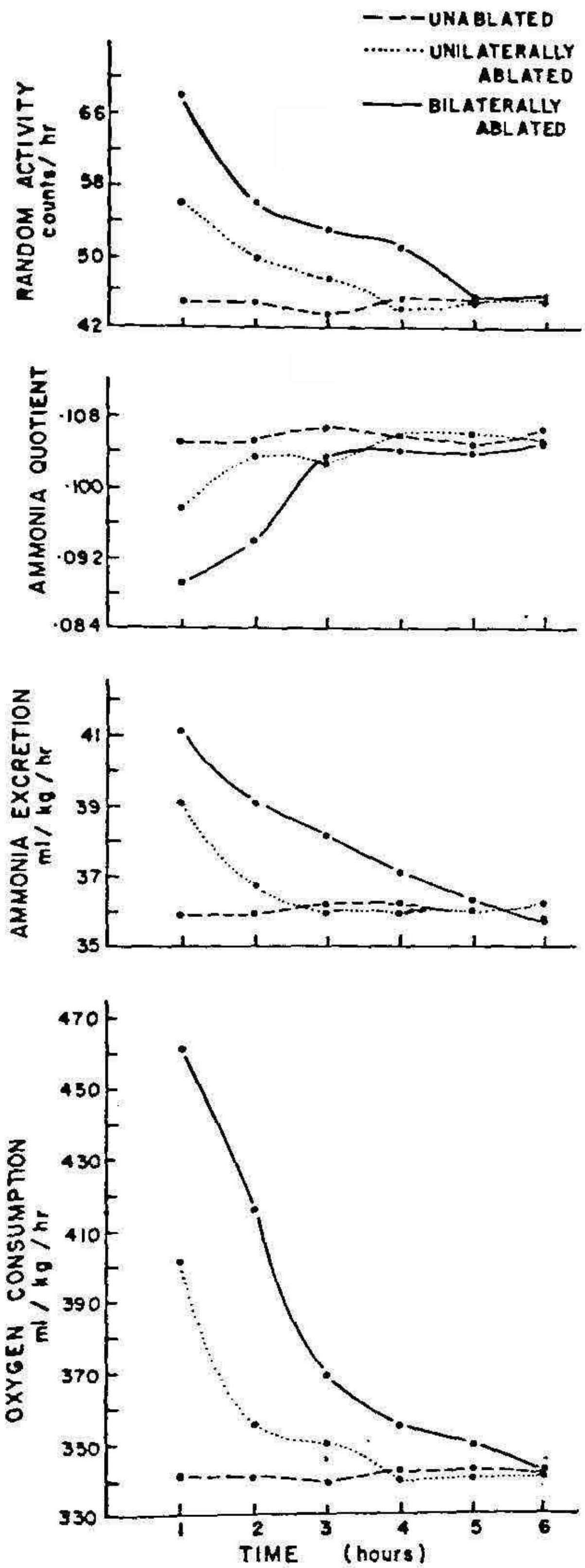
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus indicus females acclimated to and tested at 27 $\pm$ 0.5°C and 2 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 16.5 $\pm$ 0.41), and 3 unilaterally ablated (Mean weight 17.83 $\pm$ 1.03) and 3 bilaterally ablated (Mean weight 17.67 $\pm$ 0.47) prawns of the size group 120-140 mm.

TABLE - 9

Runs	Oxygen Consumption ml/Kg/hr.	Ammonia Excretion ml/Kg./hr.	Ammonia Quotient	Randum Activity Counts/hr.	
1	341.8 ± 13.37	35.92 ± 0.2243	0.1052 ± 0.0041	45.0	
2	341.8 ± 13.52	35.92 ± 0.2243	0.1055 ± 0.0042	44.8	
3	339.3 ± 13.14	36.23 ± 0.3890	0.1069 ± 0.0030	43.5	
4	342.1 ± 14.67	36.23 ± 0.3890	0.1061 ± 0.0035	45.2	Unablated
5	341.8 ± 14.6	35.92 ± 0.1466	0.1053 ± 0.0044	45.0	
6	340.6 ± 16.07	36.21 ± 0.3930	0.1065 ± 0.0040	45.0	
1	401.12 ± 25.86	39.08 ± 0.243	0.0978 ± 0.0056	56	
2	355.6 ± 22.83	36.69 ± 0.300	0.1035 ± 0.0059	50	
3	350.13 ± 19.94	35.98 ± 0.2855	0.1031 ± 0.0051	47.8	
4	340.1 ± 19.36	35.98 ± 0.2855	0.1061 ± 0.0053	44.2	Unilaterally ablated
5	340.0 ± 19.21	35.98 ± 0.2855	0.1061 ± 0.0053	43.2	
6	340.0 ± 19.21	35.78 ± 0.3236	0.1055 ± 0.0054	45	
1	461.5 ± 15.04	41.11 ± 0.1273	0.0892 ± 0.0026	68	
2	415.7 ± 12.9	39.05 ± 0.0707	0.094 ± 0.0027	56	
3	369.2 ± 9.77	38.17 ± 0.0519	0.1034 ± 0.0026	53	Bilaterally ablated
4	355.4 ± 8.13	37.09 ± 0.1603	0.1044 ± 0.0019	51	
5	349.5 ± 8.84	36.31 ± 0.2828	0.1059 ± 0.0018	45.2	
6	340.1 ± 9.89	35.74 ± 0.3201	0.1052 ± 0.0032	45.8	

Fig. 12

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 $\pm$ 0.5°C and 2 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
66
58
50
42
AMMONIA QUOTIENT
·108
·100
·092
·084
AMMONIA EXCRETION ml/kg/hr
41
39
37
35
OXYGEN CONSUMPTION ml/kg/hr
470
450
430
410
390
370
350
330
1
2
3
4
5
6
TIME (hours)

Table - 10

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 ± 0.5°C and 2 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 17.5 ± 0.41), 3 unilaterally ablated (Mean weight 17.83 ± 0.85) and 3 bilaterally ablated (Mean weight 15.67 ± 0.24) prawns of the size group 120-140mm.

TABLE - 10

Runs	Oxygen Consumption ml/kg/hr	Ammonia Excretion ml/Kg/hr.	Ammonia Quoteint	Random Activity Counts/hr.	
1	298.33 ± 5.68	29.02 ± 0.0974	0.0973 ± 0.0016	40.2	Unablated
2	298.23 ± 6.26	29.02 ± 0.0974	0.0973 ± 0.0019	39.8	
3	297.13 ± 6.08	29.02 ± 0.0974	0.0977 ± 0.0018	38.5	
4	297.47 ± 5.76	29.02 ± 0.0974	0.0976 ± 0.0017	39.5	
5	296.9 ± 5.99	29.02 ± 0.0974	0.0978 ± 0.0018	40.5	
6	297.2 ± 6.05	29.02 ± 0.0974	0.0977 ± 0.0018	40.0	
1	343.2 ± 3.97	30.91 ± 0.4101	0.0901 ± 0.0021	47	Unilaterally ablated
2	311.67 ± 3.60	30.02 ± 0.4152	0.0963 ± 0.0014	44	
3	297.8 ± 3.30	29.03 ± 0.1084	0.0975 ± 0.0007	40	
4	297.8 ± 3.30	29.03 ± 0.0988	0.0975 ± 0.0007	39.5	
5	302.9 ± 1.04	29.04 ± 0.1084	0.0959 ± 00	41	
6	297.8 ± 3.30	29.03 ± 0.0988	0.0973 ± .0007	38.8	
1	401.96 ± 11.3	34.18 ± 0.3103	0.085 ± 0.0016	51.5	Bilaterally ablated
2	357.40 ± 7.16	32.00 ± 0.1537	0.0895 ± 0.0016	48	
3	344.8 ± 9.98	31.30 ± 0.1461	0.0909 ± 0.0023	46.8	
4	327.7 ± 4.25	29.82 ± 0.1173	0.091 ± 0.0011	42	
5	314.23 ± 6.66	29.4 ± 0.2673	0.0936 ± 0.0027	41.2	
6	297.76 ± 5.96	29.02 ± 0.0974	0.0975 ± 0.0017	40	

Fig. 13

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 ± 0.5°C and 2 ppt.

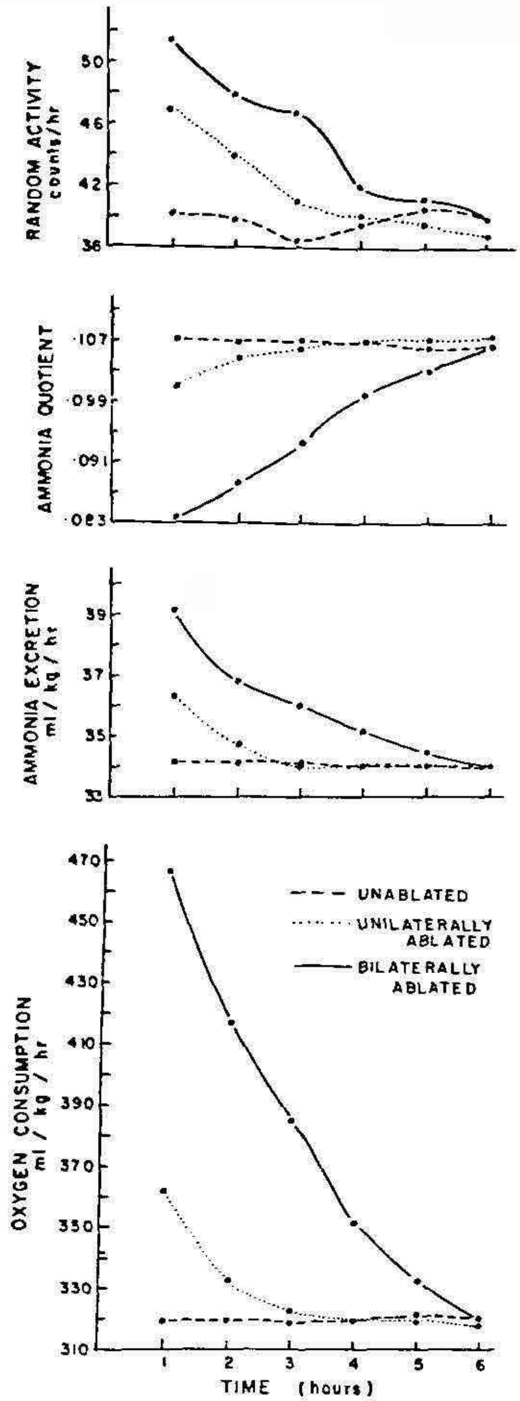

RANDOM ACTIVITY counts/hr
AMMONIA QUOTIENT
AMMONIA EXCRETION ml / kg / hr
OXYGEN CONSUMPTION ml / kg / hr
UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
TIME (hours)

Table - 11

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 $\pm$ 0.5°C and 8 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 17.5 $\pm$ 0.41) 3 unilaterally ablated (Mean weight 17.67 $\pm$ 0.24), and 3 bilaterally ablated (Mean weight 17.5 $\pm$ 0.41) prawns of the size group 120-140 mm.

TABLE - 11

Runs	Oxygen Consumption ml/Kg/hr	Ammonia Excretion Ml/Kg/Hr	Ammonia Quotient	Random Activity Counts/hr.	
1	298.33 ± 5.68	29.02 ± 0.0974	.0973 ± .0016	40.2	
2	298.23 ± 6.26	29.02 ± 0.0974	.0973 ± .0019	39.8	
3	297.13 ± 6.08	29.02 ± 0.0974	.0977 ± .0018	38.5	
4	297.47 ± 5.76	29.02 ± 0.0974	.0976 ± .0017	39.8	Unablated
5	296.9 ± 5.99	29.02 ± 0.0974	.0978 ± .0018	40.5	
6	297.2 ± 6.05	29.02 ± 0.0974	.0977 ± .0018	40	
7					
1	343.2 ± 3.97	30.91 ± 0.4101	.0901 ± .004	47	
2	311.67 ± 3.60	30.02 ± 0.4152	.0963 ± .0014	44	
3	302.9 ± 1.04	29.04 ± 0.1084	.0959 ± .00	41	Unilaterally ablated
4	297.8 ± 3.30	29.04 ± 0.1084	.0975 ± .0007	40	
5	297.8 ± 3.30	29.03 ± 0.0988	.0975 ± .0007	39.5	
6	297.8 ± 3.30	29.03 ± 0.0988	.0973 ± .0007	38.8	
1	401.96 ± 11.3	34.18 ± 0.3103	.0851 ± .0016	51.5	
2	357.4 ± 7.16	32.00 ± 0.1537	.0895 ± .0016	48	
3	344.8 ± 9.98	31.30 ± 0.1461	.0909 ± .0023	46.8	Bilaterally ablated
4	327.7 ± 4.25	29.82 ± 0.1173	.091 ± .0011	42	
5	314.23 ± 6.66	29.4 ± 0.2673	.0936 ± .0027	41.2	
6	297.76 ± 5.96	29.02 ± 0.0974	.0975 ± .0017	40	

Fig. 14

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 ± 0.5°C and 8 ppt.

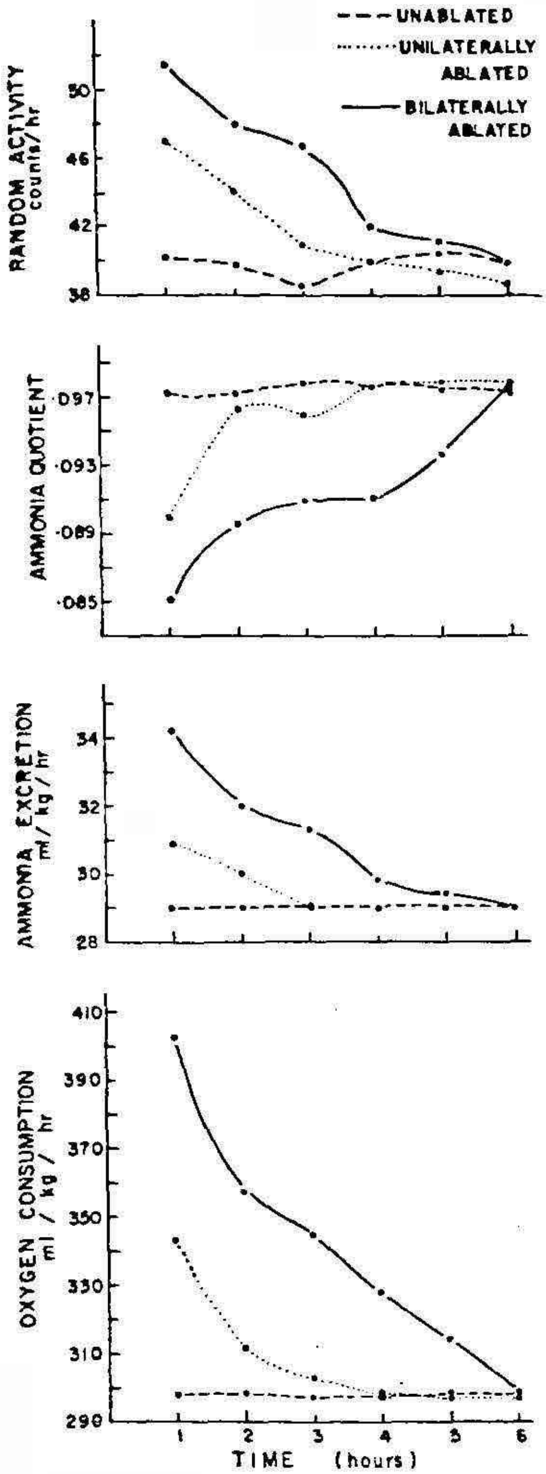

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
50
46
42
38
AMMONIA QUOTIENT
·097
·093
·089
·085
AMMONIA EXCRETION ml/kg/hr
34
32
30
28
OXYGEN CONSUMPTION ml/kg/hr
410
390
370
350
330
310
290
1
2
3
4
5
6
TIME (hours)

Table 12

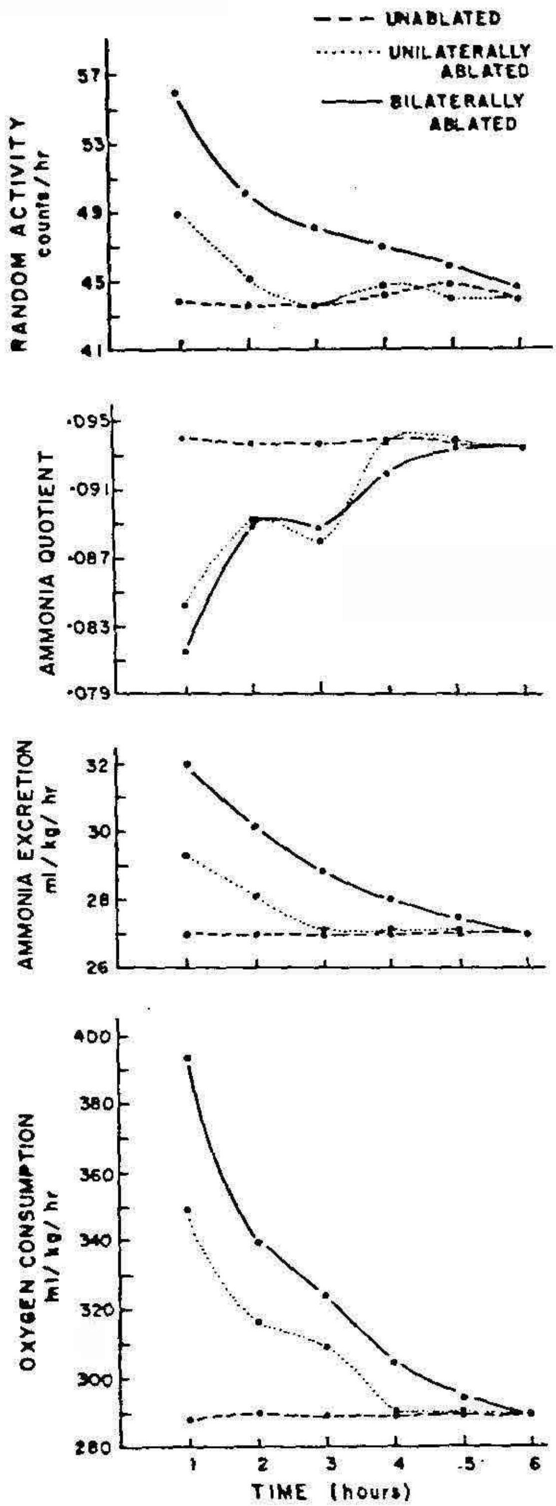
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) penaeus indicus males acclimated to and tested at 27 ± 0.5°C and 8 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 15.67 ± 0.62), 3 unilaterally ablated (Mean weight 15.83 ± 0.62), and 3 bilateraly ablated (Mean weight 16.33 ± 0.47) prawns of the size group 120-140 mm.

TABLE - 12

Runs	Oxygen Consumption Ml./Kg./hr	Ammonia Excretion ml/Kg/hr.	Ammonia Quotient	Random Activity Counts/hr.	
1	287.8 ± 15.6	26.99 ± 0.1590	.0940 ± .0048	44	
2	289.7 ± 20.9	26.99 ± 0.1590	.0937 ± .0066	43.5	
3	289.1 ± 20.9	26.95 ± 0.1873	.0937 ± .0065	43.5	
4	289.1 ± 20.9	27.04 ± 0.2286	.094 ± .0065	44.2	Unablated
5	289.3 ± 18.5	27.00 ± 0.2577	.0936 ± .0053	44.8	
6	289.3 ± 18.5	26.95 ± 0.1873	.0935 ± .0055	44.0	
1	349.4 ± 16.7	29.34 ± 0.0929	.0842 ±.0037	49	
2	315.8 ± 13.8	28.14 ± 0.0838	.0892 ± .0036	45	
3	309.3 ± 13.2	27.14 ± 0.1796	.0879 ± .0032	43.5	
4	289.8 ± 10.5	27.14 ± 0.1796	.0938 ± .0028	49.5	Unilaterally ablated
5	289.7 ± 11.2	27.09 ± 0.1236	.0937 ± .0032	44	
6	289.7 ± 11.2	27.03 ± 0.2117	.0934 ± .0030	44	
1	393.2 ± 23.6	31.95 ± 0.4107	.0815 ± .0038	56	
2	340.4 ± 13.6	30.15 ± 0.1179	.08874 ± .0032	50	
3	324.4 ± 5.8	28.77 ± 0.2263	.0887 ± .0009	48	Bilaterally ablated
4	303.5 ± 10.71	27.92 ± 0.2734	.0921 ± .0024	47	
5	293.7 ± 8.03	27.49 ± 0.1933	.0934 ± .0017	45.8	
6	289.7 ± 13.06	27.01 ± 0.1791	.0934 ± .0037	44.5	

Fig. 15

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 ± 0.5°C and ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
57
53
49
45
41
AMMONIA QUOTIENT
·095
·091
·087
·083
·079
AMMONIA EXCRETION ml/kg/hr
32
30
28
26
OXYGEN CONSUMPTION ml/kg/hr
400
380
360
340
320
300
280
1
2
3
4
5
6
TIME (hours)

Table - 13

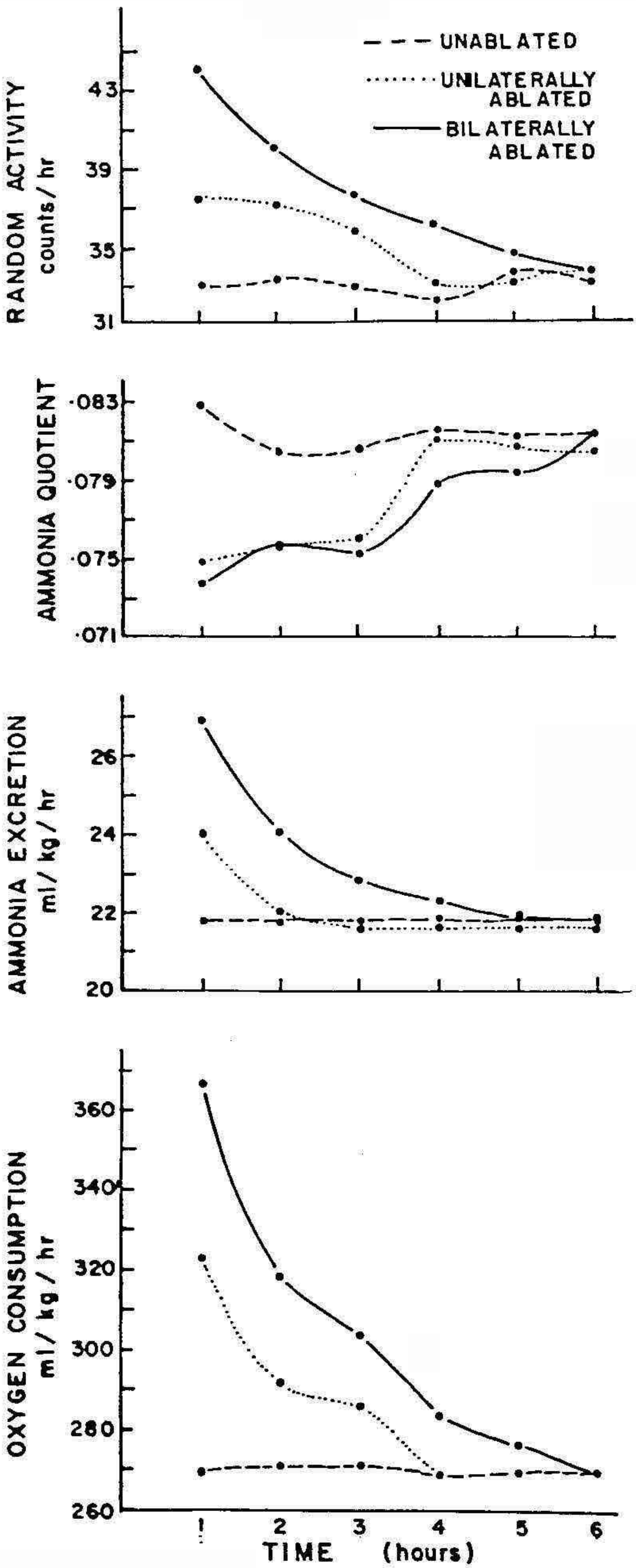
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 + 0.5°C and 17.7 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 18.$\pm$ 0.82), 3 unilaterally ablated (Mean weight 17.17 $\pm$ 0.85)and 3 bilaterally ablated (Mean weight 17.5 $\pm$ 0.41) prawns of the size group 120-140 mm.

TABLE - 13

Runs	Oxygen Consumption ml/Kg/hr	Ammonia Excretion ml/Kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	269.43 ± 18.54	21.78 ± 0.2656	.0828 ± .0053	33.0	
2	271.4 ± 18.21	21.78 ± 0.2656	.0805 ± .0043	33.5	
3	271.16 ± 14.65	21.82 ± 0.2864	.0806 ± .0032	32.8	
4	268.5 ± 15.93	21.81 ± 0.2738	.0815 ± .0037	32.2	Unablated
5	269.3 ± 15.96	21.81 ± 0.2738	.0812 ± .0037	33.5	
6	268.9 ± 15.46	21.81 ± 0.2738	.0813 ± .0036	33.0	
1	322.63 ± 18.98	24.95 ± 0.2392	.0748 ± .0044	37.5	
2	291.6 ± 16.94	22.01 ± 0.3182	.0751 ± .0042	37.0	Unilaterally ablated
3	285.6 ± 16.57	21.63 ± 0.2385	.0760 ± .0042	35.8	
4	268.0 ± 16.81	21.63 ± 0.2385	.081 ± .0050	33.0	
5	269.0 ± 18.47	21.63 ± 0.2385	.0806 ± .0053	33.2	
6	269.4 ± 18.17	21.63 ± 0.2385	.0805 ± .0052	33.5	
1	367.0 ± 22.76	26.94 ± 0.2027	.0737 ± .0040	44	
2	317.6 ± 12.27	24.02 ± 0.1594	.0757 ± .0028	40	
3	302.8 ± 6.05	22.79 ± 0.2829	.0753 ± .0015	37.5	Bilaterally ablated
4	283.2 ± 9.14	22.79 ± 0.1551	.0788 ± .0020	36.0	
5	275.8 ± 6.48	21.90 ± 0.2120	.0794 ± .0012	34.5	
6	268.5 ± 8.98	21.80 ± 0.2762	.0813 ± .0023	33.5	

Fig. 16

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 27 ± 0.5°C and 17.7 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
31
35
39
43
AMMONIA QUOTIENT
·071
·075
·079
·083
AMMONIA EXCRETION ml / kg / hr
20
22
24
26
OXYGEN CONSUMPTION ml / kg / hr
260
280
300
320
340
360
1
2
3
4
5
6
TIME (hours)

Table - 14

Rates of oxygen consumption ammonia excfetion, ammonia quotient and random activity of unablated, and ablated (unilateral and bilateral) <u>Penaeus</u> <u>indicus</u> males acclimated to and tested at 27 ± 0.5°C and 17.7 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 16.33 ± 0.47), and 3 unilaterally ablated (Mean weight 17.83 ± 0.62), and 3 bilaterally ablated (Mean weight 15.5 ± 0.41) prawns of the size group 120-140 mm.

TABLE - 14

Runs	Oxygen Consumption ml/kg/hr	Ammonia Excretion ml/kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	259.33 + 14.45	19.83 + 0.1768	.0767 + .0037	36.5	
2	258.96 + 17.33	19.83 + 0.1768	.0769 + .0047	37.2	
3	259.73 + 17.92	19.82 + 0.1910	.0767 + .0047	37.8	
4	262.87 + 17.34	19.82 + 0.1910	.0757 + .0045	36.8	Unablated
5	259.13 + 14.46	19.82 + 0.1886	.0767 + .0036	36.8	
6	263.0 + 19.91	19.82 + 0.1886	.0757 + .0053	37.0	
1	298.53 + 12.49	21.34 + 0.2733	.0716 + .0020	40.5	
2	279.4 + 7.62	20.12 + 0.1161	.0720 + .0017	37.5	
3	265.4 + 15.23	19.83 + 0.1080	.0750 + .0040	36.8	
4	259.7 + 8.97	19.83 + 0.1080	.0764 + .0024	37.0	Unilaterally ablated
5	259.7 + 8.97	19.83 + 0.1080	.0764 + .0024	37.5	
6	259.2 + 9.37	19.83 + 0.1080	.0766 + .0025	37.5	
1	353.73 + 17.53	23.93 + 0.2590	.0678 + .0026	47.0	
2	314.2 + 15.03	21.96 + 0.1802	.07 + .0027	40.2	
3	302.4 + 14.55	21.03 + 0.1605	.0696 + .0029	39.2	
4	284.3 + 13.97	20.43 + 0.2701	.072 + .0025	38.0	Bilaterally ablated
5	272.6 + 13.52	19.86 + 0.1161	.073 + .0033	37.0	
6	262.0 + 7.45	19.82 + 0.0942	.0757 + .0018	37.2	

Fig. 17

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 ± 0.5°C and 17.7 ppt.

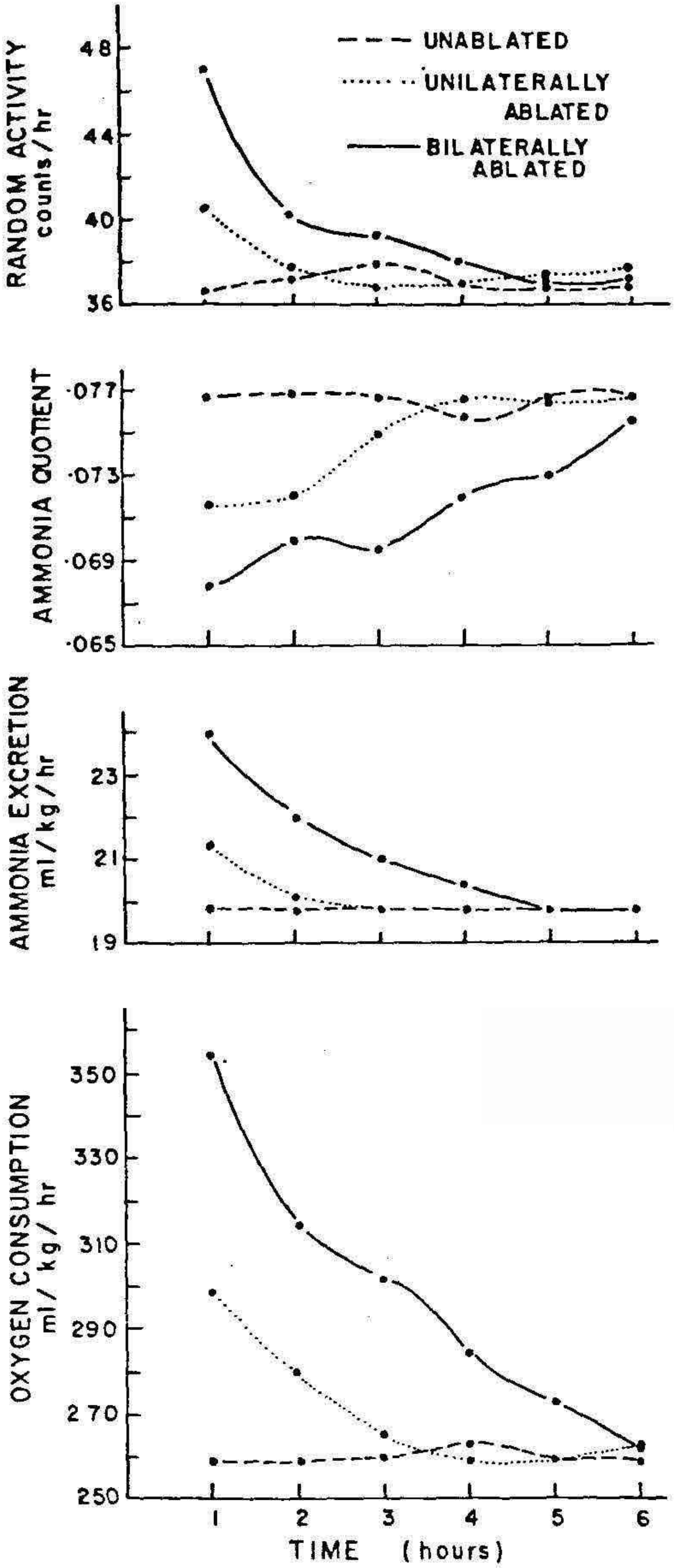

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
48
44
40
36
AMMONIA QUOTIENT
·077
·073
·069
·065
AMMONIA EXCRETION ml / kg / hr
23
21
19
OXYGEN CONSUMPTION ml / kg / hr
350
330
310
290
270
250
1
2
3
4
5
6
TIME (hours)

Table - 15

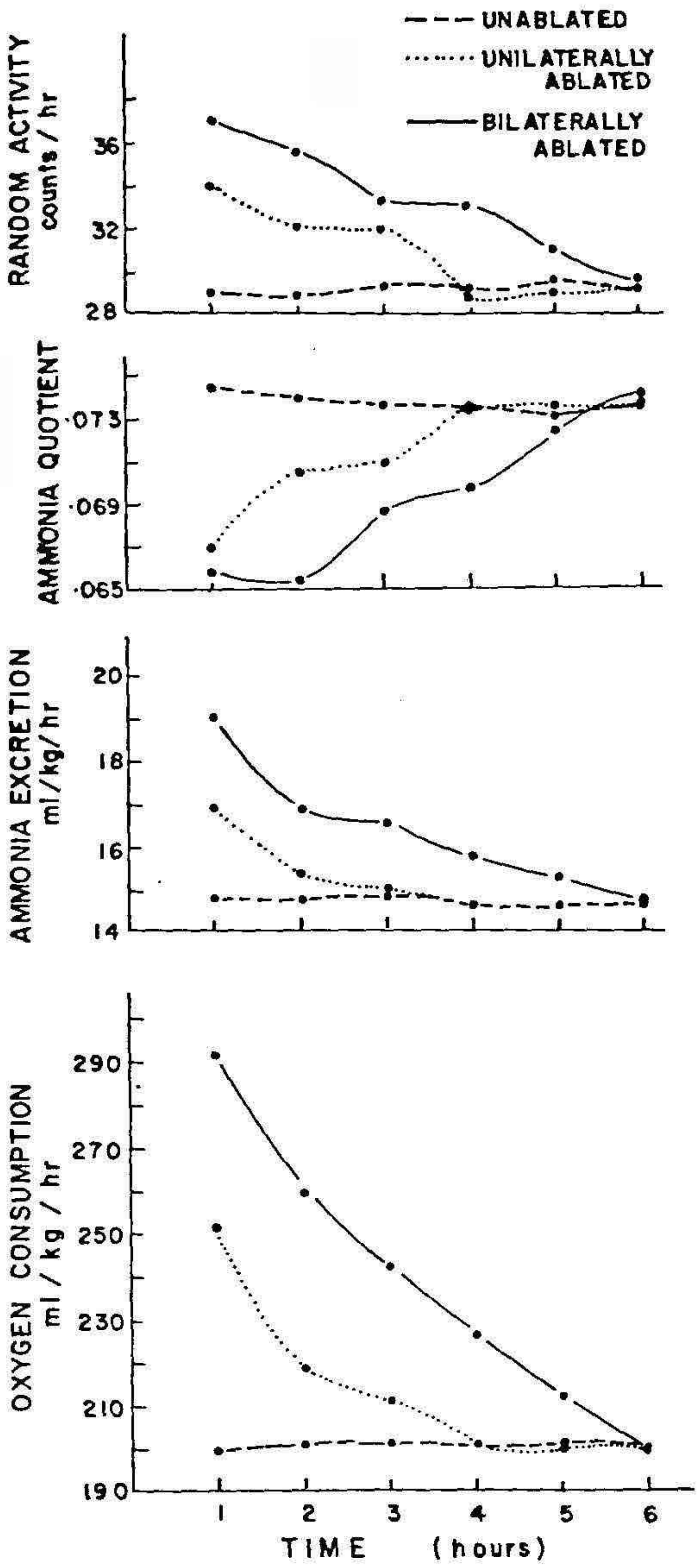
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus indicus females acclimated to and tested at 27 ± 0.5°C and 25.7 ppt. This is the summary of the results obtained from 3 unablated (Mean Weight 18 ± 0.82), 3 unilaterally ablated (Mean weight 16.83 ± 0.24) and 3 bilaterally ablated (Mean weight 17.33 ± 1.25) prawns of the size group 120-140 mm.

TABLE - 15

Runs	Oxygen Consumption ml/kg/hr	Ammonia Excretion ml/ Kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	199.7 + 20.58	14.78 + 0.5438	.0745 + .0048	29	
2	200.9 + 19.99	14.78 + 0.5438	.0740 + .0046	28.8	
3	200.8 + 17.00	14.73 + 0.4937	.0737 + .0037	29.3	
4	199.8 + 18.11	14.64 + 0.5008	.0737 + .0041	28.0	Unablated
5	200.8 + 17.00	14.64 + 0.5008	.0732 + .0036	29.5	
6	199.8 + 18.11	14.64 + 0.5008	.0737 + .0041	29.0	
1	251.8 + 2.74	16.89 + 0.0943	.0670 + .0005	34.0	
2	218.5 + 2.07	15.43 + 0.1933	.0706 + .006	32	
3	211.0 + 2.72	14.98 + 0.0094	.071 + .0009	32	Unilaterally ablated
4	200.7 + 1.88	14.62 + 0.3151	.0734 + .0024	28.8	
5	200.23 + 2.57	14.62 + 0.3151	.0736 + .0026	29.0	
6	200-23 + 2.57	14.62 + 0.3151	.0736 + .0026	29. 0	
1	291.6 + 25.08	19.05 + 0.1208	.0658 + .0054	37.0	
2	258.87 + 20.75	16.86 + 0.1533	.0655 + .0046	35.5	
3	242.03 + 16.94	16.56 + 0.1337	.0687 + .0044	33.2	Bilaterally ablated
4	225.9 + 15.83	15.71 + 0.1936	.0698 + .0041	33.0	
5	211.7 + 16.95	15.26 + 0.1606	.0725 + .0051	31.0	
6	199.6 + 18.30	14.73 + 0.4552	.0742 + .0047	29.5	

Fig. 18

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* Female acclimated to and tested at 27 $\pm$ 0.5°C and 25.7 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
36
32
28
AMMONIA QUOTIENT
·073
·069
·065
AMMONIA EXCRETION ml / kg / hr
20
18
16
14
OXYGEN CONSUMPTION ml / kg / hr
290
270
250
230
210
190
1
2
3
4
5
6
TIME (hours)

Table - 16

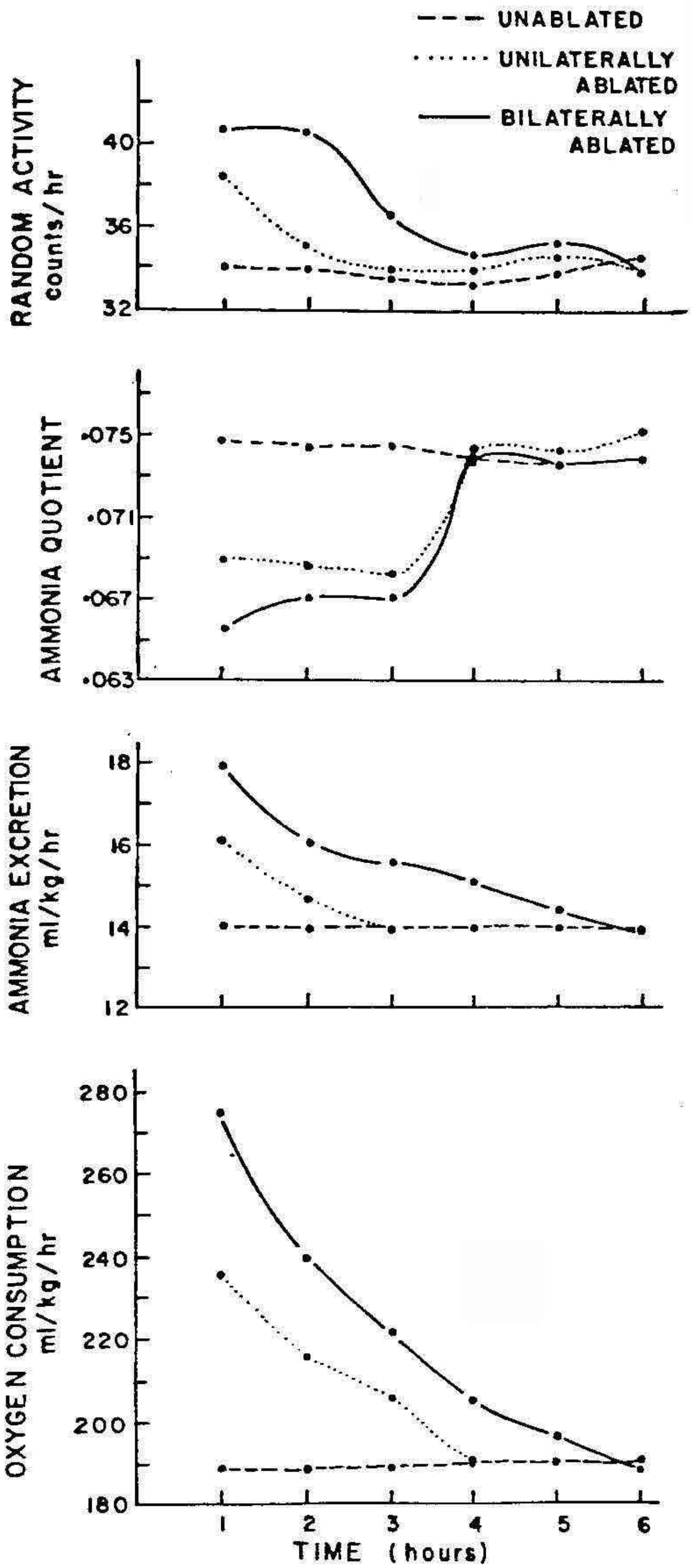
Rates of oxygen consumption, ammonia excetion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus indicus males acclimated to and tested at 27 ± 0.5°C and 25.7 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 15.33 ± 0.47) 3 unilaterally ablated (Mean weight 14.83 ± 0.85), and 3 bilaterally ablated (Mean weight 18 ± 0.82) prawns of the size group 120-140 mm.

TABLE - 16

Runs	Oxygen Consumption ml/kg/hr.	Ammonia Excretion ml/kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	187.8 ± 6.73	14.01 ± 0.1451	.0747 ± .0026	34	Unablated
2	187.8 ± 6.73	13.96 ± 0.1761	.0745 ± .0023	34	
3	187.8 ± 6.73	13.95 ± 0.1819	.0745 ± .0023	33.5	
4	189.67 ± 6.87	14.01 ± 0.1451	.0740 ± .0025	33.2	
5	189.67 ± 6.87	13.95 ± 0.1819	.0736 ± .0022	33.8	
6	188.97 ± 7.84	13.95 ± 0.1819	.0739 ± .0026	34.5	
1	234.97 ± 17.89	16.14 ± 0.1674	.069 ± .0047	38.5	Unilaterally ablated
2	215.87 ± 17.24	14.73 ± 0.0963	.0687 ± .0052	35	
3	204.9 ± 13.89	13.91 ± 0.0748	.0682 ± .0044	33.8	
4	190.3 ± 23.89	13.91 ± 0.0748	.0743 ± .0096	34.0	
5	190.3 ± 23.89	13.91 ± 0.0748	.0743 ± .0096	34.5	
6	188.2 ± 23.33	13.96 ± 0.1159	.0753 ± .0091	34.5	
1	274.2 ± 4.05	17.98 ± 0.3623	.0656 ± .0018	40.5	Bilaterally ablated
2	239.4 ± 2.87	16.07 ± 0.0899	.0671 ± .0010	40.5	
3	220.6 ± 2.80	15.66 ± 0.0849	.071 ± .0013	36.5	
4	204.3 ± 5.18	15.08 ± 0.2287	.0739 ± .0022	34.5	
5	196.0 ± 2.93	14.44 ± 0.01883	.0737 ± .0021	35.2	
6	187.67 ± 3.16	13.85 ± 0.1034	.0738 ± .0016	34.0	

Fig. 19

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* Male acclimated to and tested at 27 $\pm$ 0.5°C and 25.7 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/hr
40
36
32
AMMONIA QUOTIENT
·075
·071
·067
·063
AMMONIA EXCRETION ml/kg/hr
18
16
14
12
OXYGEN CONSUMPTION ml/kg/hr
280
260
240
220
200
180
1
2
3
4
5
6
TIME (hours)

Table - 17

Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Peaneus indicus females acclimated to and tested at 27 ± 0.5°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 17.83 ± 0.85), 3 unilaterally ablated (Mean Weight 18.17 ± 0.85), and 3 bilaterally ablated (Mean weight 18 ± 0.82) prawns of the size group 120-140 mm.

TABLE - 17

Runs	Oxygen Consumption ml/kg/hr	Ammonia Excretion ml/kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	229.8 ± 17.63	8.46 ± 0.2123	0.0369 ± 0.0021	27.0	
2	231.5 ± 16.67	8.46 ± 0.2123	0.0366 ± 0.0017	27.3	
3	235.2 ± 17.98	8.64 ± 0.2017	0.0369 ± 0.0031	26.8	Unablated
4	238.3 ± 24.45	8.65 ± 0.2379	0.0366 ± 0.0031	26.8	
5	234.8 ± 21.15	8.50 ± 0.1621	0.0365 ± 0.0030	27.2	
6	232.3 ± 17.17	8.50 ± 0.1621	0.0368 ± 0.0022	28.2	
1	270.6 ± 25.01	9.51 ± 0.741	0.0347 ± 0.0041	35.2	
2	255.2 ± 24.34	9.11 ± 0.1925	0.0354 ± 0.0036	32.2	
3	241.7 ± 30.91	8.63 ± 0.1717	0.0362 ± 0.0041	29.8	Unilaterally ablated
4	234.8 ± 21.15	8.62 ± 0.1551	0.0374 ± 0.0035	28.2	
5	234.8 ± 21.15	8.62 ± 0.1551	0.038 ± 0.0034	28.8	
6	232.3 ± 16.17	8.58 ± 0.4535	0.0374 ± 0.0034	27.6	
1	311.4 ± 18.17	10.99± 0.3456	0.0354 ± 0.0011	38.0	
2	276.5 ± 14.46	9.84 ± 0.2951	0.0356 ± 0.0009	32.0	
3	266.2 ± 14.09	9.4 ± 0.1920	0.0354 ± 0.0012	32.6	Bilaterally ablated
4	250.2 ± 13.40	8.86 ± 0.2344	0.0355 ± 0.0009	30.2	
5	239.9 ± 12.83	8.47 ± 0.2733	0.03544± 0.0008	28.8	
6	232.3 ± 16.17	8.38 ± 0.3799	0.0361 ± 0.0015	27.0	

Fig. 20

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* female acclimated to and tested at 27 ± 0.5°C and 32.4 ppt.

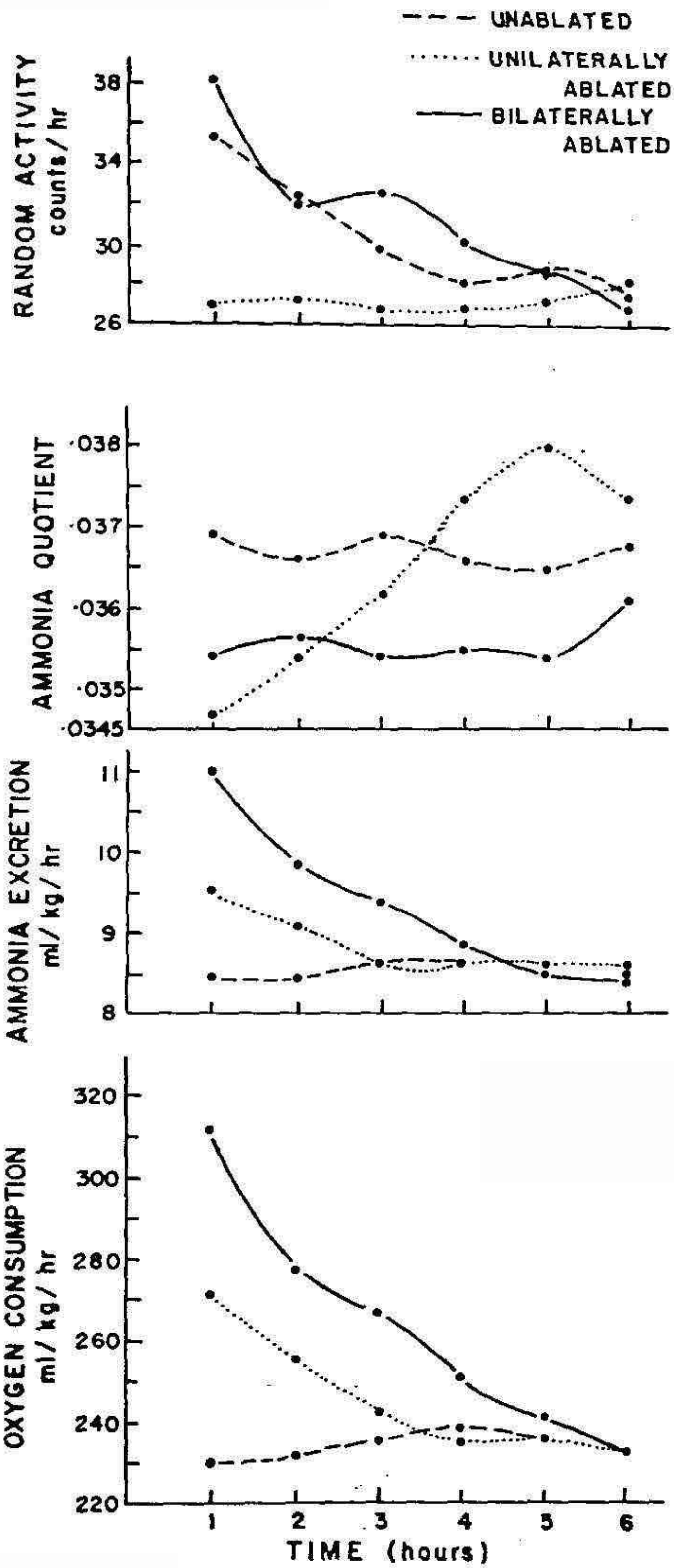

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts / hr
38
34
30
26
AMMONIA QUOTIENT
·038
·037
·036
·035
·0345
AMMONIA EXCRETION ml / kg / hr
11
10
9
8
OXYGEN CONSUMPTION ml / kg / hr
320
300
280
260
240
220
1
2
3
4
5
6
TIME (hours)

Table - 18

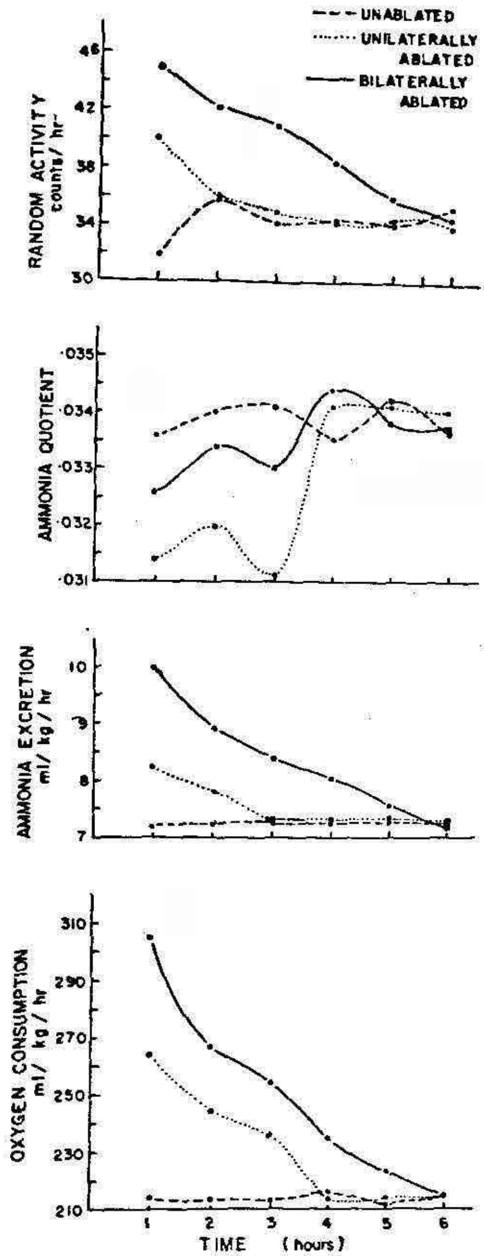
Rates of oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated (unilateral and bilateral) Penaeus indicus males acclimated to and tested at 27 ± 0.5°C and 32.4 ppt. This is the summary of the results obtained from 3 unablated (Mean weight 16 ± 0.82), 3 unilaterally ablated (Mean weight 15.33 ± 0.47) and 3 bilaterally ablated (Mean weight 15.5 ± 0.41) prawns of the size group 120-140 mm.

TABLE - 18

Runs	Oxygen Consumption ml/kg/hr	Ammonia Excretion ml/kg/hr	Ammonia Quotient	Random Activity Counts/hr.	
1	214.3 ± 11.97	7.20 ± 0.4224	0.0336 ± 0.0004	32.0	Unablated
2	213.5 ± 3.40	7.25 ± 0.4930	0.034 ± 0.0018	35.8	
3	213.1 ± 8.46	7.25 ± 0.4930	0.0341 ± 0.0022	34.3	
4	216.4 ± 4.79	7.25 ± 0.4930	0.0335 ± 0.0016	34.5	
5	211.6 ± 4.18	7.25 ± 0.4930	0.0342 ± 0.0019	34.2	
6	213.9 ± 5.70	7.18 ± 0.3894	0.0336 ± 0.0017	35.5	
1	263.5 ± 14.84	8.26 ± 0.0919	0.0314 ± 0.0014	40.0	Unilaterally ablated
2	244.4 ± 13.82	7.8 ± 0	0.0320 ± 0.0019	36.0	
3	235.4 ± 14.40	7.29 ± 0.0141	0.0311 ± 0.0019	35.0	
4	213.87± 5.70	7.29 ± .0141	0.0341 ± 0.0010	34.3	
5	213.87± 5.7	7.29 ± 0.0141	0.0341 ± 0.0010	34.5	
6	213.87± 5.7	7.27 ± .0141	.0340 ± 0.0008	34.0	
1	305.0 ± 10.86	9.95 ± 0.1396	0.0326 ± 0.0008	45	Bilaterally ablated
2	266.9 ± 7.62	8.9 ± 0.2368	0.0334 ± 0.0003	42.3	
3	254.3 ± 7.09	8.39 ± 0.2205	0.033 ± 0.0004	41.0	
4	234.2 ± 6.58	8.06 ± 0.2123	0.0344 ± 0	38.5	
5	223.0 ± 6.56	7.55 ± 0.2000	0.0338 ± 0.0005	36.0	
6	213.87± 5.7	7.19 ± 0.1021	0.0337 ± 0.0011	34.6	

Fig. 21

Oxygen consumption, ammonia excretion, ammonia quotient and random activity of unablated and ablated(unilateral and bilateral) *Penaeus indicus* males acclimated to and tested at 27 $\pm$ 0.5°C and 32.4 ppt.



UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
RANDOM ACTIVITY counts/ hr
30
34
38
42
46
AMMONIA QUOTIENT
·031
·032
·033
·034
·035
AMMONIA EXCRETION ml/ kg / hr
7
8
9
10
OXYGEN CONSUMPTION ml/ kg / hr
210
230
250
270
290
310
1
2
3
4
5
6
TIME (hours)

Table - 19a

Carbohydrate levels (in %) in the muscle tissue of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 28 ± 0.5°C and 25.5 ppt after 24 hours, 48 hours 72 hours, 96 hours and 120 hours.

Table 19b

Carbohydrate levels (in %) in the hepatopancreas of unablated and ablated (unilateral and bilateral) *Penaeus indicus* females acclimated to and tested at 28 ± 0.5°C and 25.5 ppt after 24 hours, 48 hours, 72 hours, 96 hours and 120 hours.

TABLE - 19(a)

Hours	Unablated (%)	Unilaterally Ablated (%)	Bilaterally Ablated (%)
0	2.775	2.775	2.775
24	2.2604	2.4215	3.2629
48	2.395	2.9774	2.37
72	2.3875	2.8627	1.4790
96	2.369	2.5778	1.4790
120	2.3721	2.4633	1.3719

TABLE - 19(b)

Hours	Unablated (%)	Unilaterally Ablated (%)	Bilaterally Ablated (%)
0	8.5185	8.5185	8.5185
24	7.5444	8.9579	9.2632
48	5.0557	6.9373	7.0546
72	5.1774	5.9452	1.7833
96	5.7069	4.7428	2.9383
120	5.1670	5.8347	2.7384

Fig. 22 b

Carbohydrate levels (in %) in the hepatopancreas of unablated and ablated (unilateral and bilateral) Penaeus indicus females acclimated to and tested at 28 ± 0.5°C and 25.5 ppt after 24 hours, 48 hours, 72 hours, 96 hours and 120 hours.

Fig. 22 a

Carbohydrate levels (in %) in the ~~ǂ~~ muscle tissue of unablated and ablated (unilateral and bilateral) Penaeus indicus females acclimated to and tested at 28 ± 0.5°C and 25.5 ppt after 24 hours, 48 hours, 72 hours, 96 hours and 120 hours.

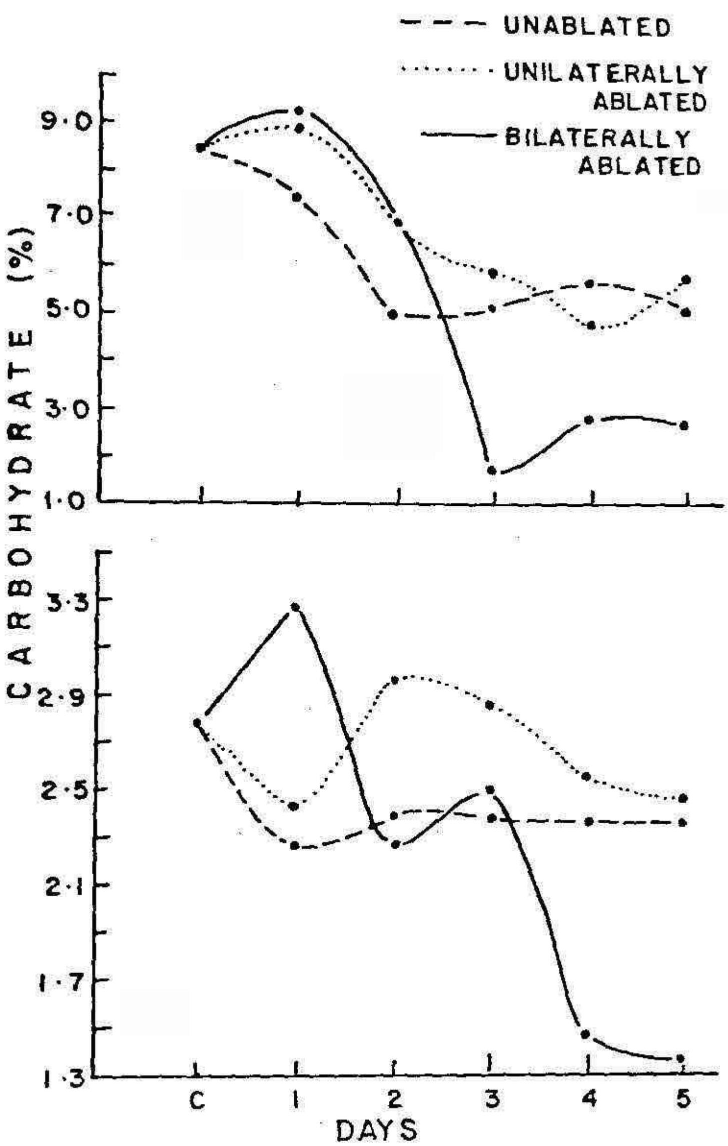

UNABLATED
UNILATERALLY ABLATED
BILATERALLY ABLATED
CARBOHYDRATE (%)
9·0
7·0
5·0
3·0
1·0
3·3
2·9
2·5
2·1
1·7
1·3
C
1
2
3
4
5
DAYS

Table - 20

Data obtained after analysis of variance of oxygen consumption of *P. indicus* acclimated to and tested at different temperatures (27, 30 & 33°C) with reference to ablated (unilateral and bilateral) prawns (both females and males)

TABLE - 20

Source	Degrees of freedom (df)	Sum of squares (SS)	Mean sum of squares (MSS)	F
Between Sexes	1	0.0006	0.0006	0.25274
Between Processes	1	0.01759	0.01759	7.40944 **
Between Temperatures	2	0.30472	0.15236	64.1786 **
Between Sexes and Processes	1	0.00004	0.00004	0.01685
Between Sexes and Temperatures	2	0.0039	0.00195	0.8214
Between Processes and Temperatures	2	0.0064	0.0032	1.34794
Error	62	0.14717	0.002374	
TOTAL	71	0.48042		

Table - 21

Data obtained after analysis of variance of ammonia, excretion of *P. indicus* acclimated to and tested at different temperatures (27, 30 & 33°C) with reference to ablated (unilateral and bilateral) prawns (both females and males).

TABLE - 21

Source	Degrees of freedom (df)	Sum of Squares (SS)	Mean sum of squares (MSS)	F
Between Sexes	1	0.04467	0.04467	53.0838**
Between Processes	1	0.00991	0.00991	11.7766**
Between Temperatures	2	2.47609	1.23805	1471.2418**
Between Sexes and Processes	1	0.00001	0.00001	0.01188
Between Sexes and Temperatures	2	0.00168	0.00084	00.9982
Between Processes and Temperatures	2	0.00079	0.0000395	0.04694
Error	62	0.05217	0.0008415	
TOTAL	71	2.58532		

Table - 22

Data obtained after analysis of variance of random (spontaneous) activity of *P. indicus* acclimated to and tested at different temperatures (27, 30 & 33°C) with reference to ablated (unilateral and bilateral) prawns (both females and males).

TABLE - 22

Source	Degrees of freedom(df)	Sum of squares(SS)	Mean sum of Squares (MMS)	F
Between Sexes	1	0.07008	0.07008	11.70165**
Betweeh Processes	1	0.04432	0.04432	7.40036**
Between Temperatures	2	0.62401	0.312005	52.0972**
Between Sexes and Processes	1	0.00101	0.00101	0 .16865
Between Sexes and Temperatures	2	0.01864	0.00932	1.5562
Between Processes and Temperatures	2	0.00421	0.002105	0.35148
Error	62	0.37131	0.0059889	
TOTAL	71	1.13358		

Table - 23

Data obtained after analysis of variance of oxygen consumption of *P. indicus* acclimated to and tested at different salinities (2, 8, 17.7, 25.7 & 32.4 ppt) with reference to ablated (unilateral and bilateral) prawns (both females and males).

TABLE - 23

Source	Degrees of Freeom(df)	Sum of Squares(SS)	Mean sum of squares (MSS)	F
Between Sexes	1	0.02106	0.02106	11.7851**
Between Processes	1	0.03452	0.03452	19.31729**
Between Salinities	4	0.63779	0.15945	89.22776**
Between Sexes and Processes	1	0.00001	0.00001	00.005596
Between Sexes and Salinities	4	0.00698	0.001745	0.9765
Between Processes and Salinities	4	0.00024	0.00006	0.03358
Error	104	0.18585	0.001787	
TOTAL	119	0.88645		

Table - 24

Data obtained after analysis of variance of ammonia excretion of P. indicus acclimated to and tested at different salinities (2, 8, 17.7 xx 25.7 & 32.4 ppt) with reference to ablated (unilateral and bilateral) prawns (both females and males).

TABLE - 24

Source	Degrees of Freedom(df)	Sum of Squares(SS)	Mean sum of squares	F
Between Sexes	1	0.07076	0.07076	90.6064**
Between Processes	1	0.01757	0.01757	22.49795**
Between Salinities	4	5.53569	1.3839	1772.0498**
Between Sexes and Processes	1	0.00016	0.00016	0. 20488
Between Sexes and Salinities	4	0.01794	0.004485	5.7429**
Between Proceeses and Salinities	4	0.00105	0.0002625	0.3361
Error	104	0.08122	0.00078096	
TOTAL	119	5.72439		

Table - 25

Data obtained after analysis of variance of random activity of *P. indicus* acclimated to and tested at different salinities (2, 8, 17.7, 25.7 & 32.4 ppt) with reference to ablated (unilateral and bilateral) prawns (both females and males)

TABLE - 25

Source	Degrees of Freedom(df)	Sum of Squares (SS)	Mean sum of Squares(MSS)	F
Between Sexes	1	0.02069	0.02069	14.9613**
Between Processes	1	0.02928	0.02928	21.1729**
Between Salinities	4	0.41815	0.10454	75.5948**
Between Sexes and Processes	1	0.00002	0.00002	0.01446
Between Sexes and Salinities	4	0.07438	0.018595	13.44638**
Between Processes and Salinities	4	0.00008	0.00002	0.01446
Error	104			
TOTAL	119	0.68642		

b) <u>At temperatures 27°C, 30°C and 33°C</u>

At 27°C, the mean ammonia quotient for unablated females was 0.0367 and that of males was 9.0338. In females unilateral ablation caused a decrease in ammonia quotient to 0.0347 initially and reached the control value after 4 hours and after bilateral ablation, the ammonia quotient value decreased to 0.354 initially and after 7¼ hours it reached 0.0361 only(Table 3 and Fig.6).

In males, unilateral ablation caused a considerable decrease initially and the value was 0.0314 and then it reached the control level around 4¾ hours and then it went above the control value for the rest of the experiment. Here, after bilateral ablation, the value initially obtained was 0.0326 and then it reached the normal level after 6 hours (Table 4, Fig. 7).

At 30°C, the mean ammonia quotient for the unablated females was 0.0544 and that of males was 0.0554. In females, unilateral ablation caused a reduction in the initial value to 0.0516 and then it crossed the control value after 3 hours and remained at a higher level than that of control value.

Bilateral ablation caused a considerable decrease in ammonia quotient value initially, which was 0.0502 and reached the normal value after 2¼ hours and then went on increasing, and at the end of 7¼ hours the value was 0.0619 (Table 5, Fig. 8).

In males, unilateral ablation caused a decrease in the ammonia quotient value and it was 0.0489 initially and then it increased slowly with time and it increased abruptly but did not reach the value of the control even after 7¼ hours. Bilateral ablation also caused a decrease initially to 0.0465 but there was a steady increase and it reached the normal value after 7 hours (Table 6 and Fig.9).

At 33°C, the mean ammonia quotient in females was 0.0782 and after unilateral ablation, the level fell down to 0.0645 and it slowly increased and it reached 0.0775 after 7¼ hours. Bilateral ablation also caused a decrease initially and the initial value of 0.0636 rose steadily with time and after 7¼ hours it reached the value of the control. (Table 7, Fig.10).

In males, the mean was found to be 0.0677 in unablated animals and it was the same initially after unilateral ablation and it increased above the mean value after 2½ hours. In bilateral eyestalk removed prawns, there was an initial low level of ammonia quotient (0.0550) and it reached the normal value after 7 hours.(Table 8, Fig.11).

In general, ammonia quotient is low in males than females and bilateral ablation results in the initial lowering of ammonia quotient considerably than that of unilateral ablation. Temperature has also an effect on ammonia quotient since ammonia quotient increases with increase in temperature.

c) <u>At salinities of 2ppt, 8ppt, 17.7 ppt, 25.7ppt and 32.4ppt.</u>

At 2ppt, the mean ammonia quotient value was found to be 0.1059 in females and 0.0976 in males. Unilateral ablation in females results in lowering of the ammonia quotient value to 0.0978 initially and it rises and reaches the control value after 4½ hours. In bilaterally ablated females, the initial reduction is very prominent and it reaches the control value after 6 hours.

Unilateral ablation in males caused a reduction in ammonia quotient value to 0.0901 and then it reached the normal value after 4¾ hours. Bilateral ablation resulted in an initial decrease to 0.085 and it reached the control values after 7¼ hours. (Table 9 & 10, Fig. 12 & 13).

At 8 ppt, the mean ammonia quotient value for females was 0.0976. Unilateral ablation resulted in a decrease in the ammonia quotient value and it reached normalcy after 4¾ hours and bilateral ablated animals ammonia quotient reached normalcy after 7¼ hours after initially decreasing to 0.0851 and slowly increasing with time (Table 11, Fig. 14).

In males, the mean ammonia quotient value was 0.0938 and after unilateral ablation, it decreased initially to 0.0842 and then reached normalcy after 4¾ hours. After bilateral ablation also there was a decrease in the initial value (0.0815) but it was more pronounced than that of unilateral and it reached a steady state after 6 hours. (Table 12, Fig. 15).

At 17.7 ppt, the mean ammonia quotient value was 0.0812 in females. Unilateral ablation in females caused the ammonia quotient value to decrease initially to 0.0748 and then it increases and reaches a steady state after 4¾ hours. After bilateral ablation the initial value was 0.0737 and it increased and reached 0.0813, the control value after 7¼ hours. (Table 13, Fig.16).

In unablated males, the mean ammonia quotient value was found to be 0.0764 and after unilateral ablation the initial value was 0.0716 and it reached the value of control after 4¾ hours. When bilateral ablation was done in males, the initial value showed considerable variation from the normal and it was 0.0678 and then it increased slowly and at the end of 7¼ hours it was 0.0757. (Table 14, Fig.17).

At 25.7 ppt, in females the mean ammonia quotient of unablated animals was 0.0738 and in that of unilaterally ablated animals, during the first hour it was 0.0670 and it reached a steady state after 4¾ hours. In bilaterally ablated animals, the initial value was very low than that of control and it reached the value of unablated prawns after 7 hours. (Table 15, Fig.18).

In unablated males, the mean ammonia quotient value was found to be 0.0742 and it decreased when unilateral ablation was done. The initial value was 0.069 after unilateral ablation and it reached normalcy after 4¾ hours. After bilateral ablation, the initial value was as low as 0.0656 and then it slowly increased and reached a steady state after 4¾ hours. (Table 16, Fig.19).

At 32.4 ppt, the mean ammonia quotient for unablated females and males were 0.0367 and 0.0338 respectively. After unilateral ablation it decreased to 0.0347 and reached normalcy after 3½ hours in females and it first was 0.0314 and then increased and reached a normal state after 4¾ hours in males. In bilaterally ablated females, the value came down to 0.0354 initially and then it showed a tendency to remain at that same value and after 7¼ hours reached 0.0361. In males, the value went down to 0.0326 and it reached normalcy after 6 hours. (Table 17 & 18, Fig.20 & 21).

In general, the ammonia quotient values were high in lower salinities and low in higher salinities and it was highest at 2 ppt and lowest at 32.4 ppt. Females also have a higher ammonia quotient value when compared to that of males.

4. Random (spontaneous) activity:

a) At 27 $\pm$ 0.5°C and full strength sea water:

The mean randon(spontaneous) activity at temperature 27$\pm$0.5°C and salinity 32.4 ppt was 28.1 counts/hr in unablated females and 32.92 counts/hr in unablated males. After unilateral ablation, there was an increase in activity in females and males and in females it went upto 36.5 counts/hr and then reached the normal value after 4¾ hours and in males it was 40.8 counts/hr initially and then it fell to that of normal value after 3½ hours(Table 1, & 2, Fig. 4 & 5).

Bilateral ablation in females causes an increase in activity and it is 40.1 counts/hr initially andit slows down as experiment proceeds and it reaches a normal state after 7¼ hours. In males also, there is a sudden increase in activity which goes upto 47 counts/hr and then slowly slows down and reaches a normal state after 7¼ hours.

b) At temperatures 27°C, 30°C and 33°C:

At 27°C, mean activity of unablated females was found to be 27.22 counts/hr and that of unablated males is 34.38 counts/hr. In unilateral female, the value rose to 35.2 counts/hr and then reached a steady state after 3½ hours and in males, the initial value was 40 counts/hr and it reached normalcy after 4¾ hours.

In bilaterally ablated females, the value went up to 38 counts/hr initially and then reached a normal state after 7¼ hours and in males also the activity reached normalcy after 7¼ hours after initially rising upto 45 counts/hr. (Table 3 & 4, Fig, 6 & 7).

At 30°C, the mean random activity for unablated female is found to be 17.82 counts/hr and unilateral ablation caused a spontaneous increase to 23 hours/hr and then it dropped down to a steady state after 2½ hours. In bilaterally ablated female, the initial value went upto 26 counts/hr and then it reached normalcy only after 7¼ hours (Table 5, Fig.8). /counts

In males, the mean activity value in unablated ones is found to be 21.95 counts/hr and in unilaterally ablated ones, it rose to 30 counts/hr and reached the normal value after 4¼ hours and after bilateral ablation normalcy was found to reach only after 7¼ hours after first rising to 33 counts/hr and then decreasing gradually. (Table 6, Fig.9).

At 33°C, the unablated females showed a mean random activity of 14.08 counts/hr and 18.17 counts/hr in unablated males. The value after unilateral ablation rose to 24 counts/hr and readhed normalcy after 6 hours in females and it rose to 27 counts/hr and reached normalcy in 3¾ hours in males. (Table 7 & 8, Fig. 10 & 11).

reached/

Bilateral ablation also caused an initial increase to 36.0 counts/hr in females and it fell down to normalcy after 7¼ hours and in males it rose upto 35 counts/hr initially and reached a steady state after 3½ hours.

It was found that the activity was more at 27°C and became less as temperature increased. It was also evident that females exhibited lesser rate of activity than males.

c) <u>At salinities 2 ppt, 8ppt, 17.7 ppt, 25.7 ppt, and 32.4 ppt</u>:

At 2ppt, the mean random activity in unablated females was 44.75 counts/hr and in unablated males it was 39.25 counts/hr. In unilaterally ablated female, it rose upto 56 counts/hr and then dropped to normalcy after 4¾ hours and in males normalcy was reached after the same time after initially rising upto 47 counts/hr. In bilaterally ablated females, the activity initially rose to 68 counts/hr and dropped to normalcy after 6 hours and in bilaterally ablated animals, after initially rising upto 51.5 counts/hr it came down to a normal state after 7¼ hours.
(Table 9 & 10, Fig. 12 & 13).

At 8 ppt, the unablated females showed a mean activity of 39.25 counts/hr and it reached normalcy after 4¾ hours after rising upto 47 counts/hr and in bilaterally ablated females after initially increasing upto 51.5 counts/hr, the activity retained normalcy after 7¼ hours.
(Table 11, Fig.14).

In males, the unablated animals' activity was 44 counts/hr and after an eyestalk was removed it increased to 49 counts/hr before dropping down to normalcy during the 6th hour. Removal of both eyestalks resulted in an increase of the activity to 56 counts/hr before it reached the value obtained for unablated prawns after 7¼ hours (Table 12, Fig.15).

At 17.7 ppt, the mean activity was found to be 33 counts/hr and 37.02 counts/hr in unablated females and males respectively. After unilateral ablation the activity increased to 37.5 counts/hr and then came back to normal after 4¾ hours in females and in males it increased to 40.5 counts/hr and then dropped down to normalcy also after 4¾ hours. Bilateral ablation increased the activity to 44 counts/hr initially in females and the same reading in males was 47 counts/hr. It reached normalcy after 7¼ hours in males and after 6 hours in females. (Table 13 & 14, Fig.16 & 17)

At 25.7 ppt, the mean random activity of unablated females was 29.1 counts/hr and this after unilateral ablation, rose to 34 counts/hr before dropping near to normal value after 6 hours. Bilateral ablation caused a increase in activity to 37 counts/hr and it was brought down to normalcy only after 7¼ hours. (Table 15, Fig.18).

In males, the mean random activity of unablated prawns was 33.83 counts/hr and after unilateral ablation went upto 38.5 counts/hr before retaining moralcy after 3½ hours. The activity at first was 40.5 counts/hr and it came to normalcy after 7¼ in bilaterally ablated males (Table 16, Fig.19).

At 32.4 ppt, the mean activity of unablated females, were found to be 27.22 counts/hr and that of males was 34.38 counts/hr. The initial value after unilateral ablation in females was 35.3 counts/hr and in males it was 40 counts/hr. In females, it reached normalcy after 4¾ hours.

Bilateral ablation in females caused the initial value to rise to 38 counts/hr and in males to 45 counts/hr and normalcy was reached in both after 7¼ hours. (Table17 & 18, Fig. 20 & 21).

Spontaneous activity was found to decrease with increase in salinity and that females exhibited lesser activity than males.

5. Carbohydrate levels in hepatopancreas and muscle tissue:

In the muscle tissue the initial carbohydrate content of unablated animals at zero hour was 2.775% and it fell down to 2.2604% after 24 hours and then rose to 2.395% after 48 hours and was found to stabilize around this value till the end of the expiriment(till 120 hours) (Table 19a, Fig.22a).

In unilaterally ablated animals, initially there was a decrease from the zero hour value after 24 hours and then there was in increase to 2.9774% after 48 hours and then it slowly reduced and at the end of 120 hours, it was 2.4633%.

In bilaterally ablated animals, after 24 hours there was a remarkable increase in carbohydrate content (3.2629%) and then there was a sudden fall to 1.4790% and it continued at the same level and at the end of 120 hours at % of carbohydrate in the muscle was 1.3719% (Table 19a, Fig.22 a)

Carbohydrate levels of hepatopancreas also showed a similar trend as that seen in muscle tissue(See Fig.22 b and Table 19b).

In unablated animals, from the zero hour value of 8.5185%, first there was a decrease to 7.5444% after 24 hours and then after 48 hours it came down to 5.0557% and then the level of carbohydrate was almost same till the end of 24 hours. After unilateral ablation, the value increased to 8.9579% after 24 hours and then it fell down and after 120 hours it was 5.8347%.

In bilaterally ablated animals, after 24 hours after ablation, the value rose from 8.5185% to 9.2632% and after 48 hours it reached 7.0546% and then it fell down abruptly to 1.7833% after 72 hours and remained almost at the same level till the end of the 5th day.

6. Statistical analysis:

a) At different temperatures (27, 30 & 33°C):

Analysis of variance shows that Oxygen consumption between unilaterally and bilaterally ablated animals and between the three temperatures are highly significant (Table 20).

It also shows that ammonia excretion between males and females, between unilaterally and bilaterally ablated prawns, and between the three temperatures are highly significant (Table 21).

It is also evident from the analysis that random activity between males and females, between unilaterally and bilaterally ablated prawns and between temperatures are highly significant (Table 22).

Analysis of variance also indicates that the interactions between the sexes and temperatures, sex and processes and between processes and temperatures for oxygen consumption, ammonia excretion and random activity are not significant.

b) <u>At different salinities (2 ppt, 8 ppt, 17.7 ppt, 25.7 ppt and 32.4 ppt):</u>

Analysis of variance shows that oxygen consumption between males and females, between unilaterally and bilaterally ablated prawns and between different salinities are highly significant (Table 23).

It also shows that ammonia excretion and random activity between males and females, between unilaterally and bilaterally ablated prawns and between different salinities are highly significant(Table 24 and 25).

The interactions between sexes (males and females) and salinities is highly significant for ammonia excretion and random activity. But the interactions, between sexes and processes and processes and salinities are not significant (Table 24 and 25).

DISCUSSION

The data obtained, on the effect of eyestalk removal on the metabolism of adult intermoult Penaeus indicus (females and males) acclimated to and tested in 3 temperatures (27, 30 and 33°C) and 5 salinities (2, 8, 17.7, 25.7 and 32.4 ppt) can be discussed under the following categories.

1. Effect of eyestalk removal on oxygen consumption.
2. Effect of eyestalk removal on ammonia excretion.
3. Effect of eyestalk removal on random (spontaneous) activity.
4. Effect of eyestalk removal on carbohydrate levels in hepatopancreas and muscle.

In the present investigation, oxygen consumption as an index of energy utilization and ammonia excretion as an index of protein metabolism are studied in Penaeus indicus after eyestalk removal carbohydrate levels in the eyestalk ablated P. indicus were studied to find out the hormonal control. As pointed out earlier, studies combining oxygen consumption and ammonia excretion are few in crustaceans. There are no studies on the ammonia quotient of eyestalk ablated prawns. The term ammonia quotient (A.Q) was proposed by stroganov (1962) for the proportion of ammonia excreted (in weight) to oxygen consumed (in volume) by fish. Kutty (1972) revived the terms and used it as a proportion of volume of ammonia excreted to volume of oxygen consumed(mole to mole relation). Laxminarayana(1980) first extended the concept of Ammonia Quotient as an index of protein metabolism in crustaceans.

1. Effect of eyestalk removal on the rate of oxygen consumption:

From the results it is clear that the rate of oxygen consumption of unilaterally ablated prawns was found to increase immediately after eyestalk ablation. Later the value came down and reached the value obtained for unablated prawns in 5 hours.

The rate of oxygen consumption was found to increase with increase in temperature and it was the highest at 33°C. The rate of unilaterally ablated female was always found to be higher than that of males.

The rate of oxygen consumption of unilaterally ablated *P. indicus* also decreased with increase in salinity. It was found to be the minimum at 25.7 ppt. In different salinities also the rate of oxygen consumption was higher in females than in males.

The bilaterally ablated *P. indicus* showed an initial rise in oxygen consumption higher than the level shown by unilaterally ablated prawns and the oxygen consumption rate came to the normal level 7 hours after ablation. The rate of oxygen consumption of bilaterally ablated prawns also increased with increase in temperature and decreased with increase in salinity and the minimum rate was obtained at 25.7 ppt.

The present observations on the eye/ablated *P. indicus* is in agreement with the results obtained by earlier workers. Scudamore(1947) was the first to demonstrate that the removal of the sinus gland from within the eyestalk of the crayfish, *Oreonectes immunis* led to an increase in oxygen consumption and further injection of eyestalk extract decreased the respiratory rate in destalked animals. Edwards(1950) working with *Uca pugilator* and Bliss(1953) working with *Gecarcinus lateralis* showed an increase in the metabolic rate following eyestalk removal. Fingerman(1955), Sarojini and Nagabhushanam (1968) and Chinnayya (1970) also found that the respiratory rate increased after eyestalk ablation. On the contrary Teyan *et al.*,(1959) and Nagabhushanam and Chinnayya(1968) observed no increase in oxygen consumption after eyestalk ablation in *Uca pugilator*, *Uca pugnax* and *Gelasimus annulipes*. Diwan and Nagabhushanam(1972) found that removal of eyestalk resulted in decrease in the rate of oxygen in the crab, *Barytelphusa cunicularis*.

The rate of oxygen consumption increased with increase in temperature in both unilaterally and bilaterally ablated prawns in both the sexes and the rate was the highest at 33°C. Oxygen consumption of the eyeablated females was always higher than that of the males.

Silverthorn(1973) studied the oxygen consumption of eyestalkless *Uca* acclimated to two temperatures (10 & 25°C). He observed that the oxygen consumption of the eyestalk ablated crabs increased significantly over that of controls. He also noted that seasonal influence in oxygen consumption were eliminated upon eyestalk removal. The X-organ*/Sinus gland complex of fiddler crabs (*Uca pugilator*) has been implicated in regulation of oxygen consumption in response to thermal acclimation(Silverthorn,1975a, b). The same author (1975) also found the presence of a respiration depressing hormone in the eyestalks of warm acclimated crayfish.

The rate of oxygen consumption of the eye ablated (unilateral and bilateral) prawns generally decreased with increase in salinity except in 25.7 ppt where it was the minimum. This indicates that the eye ablated *P. indicus* expends least energy in this salinity. Eye ablated females consumed more oxygen in different salinities than the males.

2) Effect of eyestalk removal on ammonia excretion:

The rate of ammonia excretion increased after unilateral eyestalk ablation and reached the normal value after 6 hours of ablation. After bilateral ablation the increase in ammonia excretion was higher than after unilateral eyestalk ablation and the normal value was obtained after 7 hours after eyestalk ablation.

As mentioned earlier the nitrogen excretion in crustaceans is less studied. It has been known that there is substantial synthesis of protein during the intermoult period between ecdysis (Renaud, 1949) and the incorporation of labelled amino acids into protein have been studies by Skinner(1965, 1966 a, b), Kurup and Scheer(1966), Yamaoka (1974) and Raghavaiah(1977). Evidence that the eyestalks of crustaceans produce factors influencing incorporation of amino acids into protein has been reported by Gorell and Gilbert(1971), McWhinnie and Mohrherr(1976) and Raghavaiah(1977).

Extirpation of the eyestalk is known to influence various aspects of metabolism of nitrogen and carbohydrates (Thornborough,1968; McWhinnie and Mohrherr,1970; Gorell and Gilbert,1971 and others). It has been shown that restriction of elimination of non protein nitrogen(NPN), the rate of which increases four or five fold immediately(24 hours) and persistently(7 days) after eyestalk removal to a degree significantly greater than that following a non-specific injury.

Raghavaiah *et al.*,(1980) found that in the field crab *Oziotelphusa senex senex*, the eyestalks normally secrete during intermoult one or more factors inhibiting the catabolism of nitrogen components of the tissues. They also observed that the "undetermined fraction" of NPN which may include trimethylamine oxide, glycine betaine or other substances (Schoffeniels and Gilles, 1970) increases after eye stalk removal and returned to the control level after injection of eyestalk extracts.

It has been shown that of the known three end products eliminated, NH_3 is the chief component, as in aquatic animals in general (Ramamurthi and Scheer, 1968). Raghavaiah et al., (1980) found that the rate of elimination of ammonia increases significantly after eyestalk ablation and is restored immediately to control level by injection of eyestalk extract. Most of the ammonia eliminated is probably derived from deamination of amino acids and from hydrolysis of amide groups of glutamine and aspargine and it is inferred that the eyestalk principle acts to inhibit these processes. It was observed that the increased rate of elimination of ammonia after eyestalk removal is only partly reflected in its concentration in the tissues, but administration of eyestalk extracts resulted in significant decrease in ammonia in all tissues except hepatopancreas.

Raman et al., (1981) also observed that bilateral eyestalk ablation of Macrobrachium lanchesteri led to an increase in ammonia excretion indicating that eyestalk may have a principle/s in the regulation of ammonia excretion.

The present observations in P. indicus are in agreement with the earlier observations on other crustaceans.

The present study was undertaken in three temperatures namely 27, 30 and 33°C. In unilaterally and bilaterally ablated P. indicus the rate of ammonia excretion increased with increase in temperature and decreased with increase in salinity. The females exhibited higher rate of ammonia excretion. The minium m rate of ammonia excretion was observed at 27°C and maximum at 33°C. Among different salinities, the minimum rate of ammonia excretion was found to be in 32.4 ppt and maximum at 2 ppt. These results indicate that relation of proteins is higher at 27°C and 32.4 ppt. These observations are of great value in the brood stock management of this commercially important prawn.

The ammonia quotients decreased immediately after eyestalk ablation (unilateral and bilateral). The ammonia quotients increased with increase in temperature and decreased with increase in salinity of the medium in both unilaterally and bilaterally ablated P. indicus, the females always had higher values of A.Q. than the males. These observations indicate that relative protein utilization was the minimum at 27°C and 32.4 ppt. These observations are also useful in brood stock management of P. indicus.

3) Effect of eyestalk removal on random activity:

The random activity of unilaterally ablated *Penaeus indicus* increased significantly and reached the normal value (Value obtained for unablated prawns) after 3½ hours. The random activity decreased with increase in temperature and increased with decrease in salinity. Males showed more activity than the females.

The random activity of *P. indicus* increased drastically after bilateral eyestalk ablation and reached normal value only after 7¼ hours. The random activity decreased with increase in temperature and decreased with increase in salinity. The random activity was minimum at 25.7 ppt where oxygen consumption was also minimum.

As already indicated, studies on the random activity of eye ablated *P. indicus* are few. Analysis of the locomotory rhythms by Naylor(1958). Naylor and Williams(1968), Naylor *et al.*,(1973), Arechiga *et al.*,(1974) and Arechiga and Naylor *et al.*, have led to the conclusion that the endogenous component of the rhythm is associated with a locomotor inhibiting hormone secreted in the eyestalk neuro-endocrine complex. This hormone is periodically released from the eyestalks to produce a rhythimic pattern of locomotor activity. The total activity was reported to decrease in eyestalk ablated crayfish(Kalmus,1938).

Uca(Edwards,1950), Trichodactylus(Valente and Edwards(1955) and Carcinus(Powell,1965). Ablation in Carcinus initially produced high activity followed after a few days by hypoactivity but hyperactivity is re-established after a period of 1-6 days. (Naylor and Williams,1968). The hypoactivity recorded by Powell(1965) in eyestalkless Carcinus is attributed to a stage of post operative shock(Naylor and Williams,1968).

In the present study also hyperactivity was observed immediately after eyestalk ablation as observed in Carcinus.

4) Effect of eyestalk removal on carbohydrate levels in hepatopancreas and muscle:

In the muscle tissue of unilaterally ablated prawns, initially there was a decrease from the zero hour value after 24 hours. After 48 hours there was an increase and then it slowly reduced. In bilaterally ablated prawns, after 24 hours there was a remarkable increase in carbohydrate content and then there was a sudden fall and continued in the same level.

Carbohydrate levels in hepatopancreas decreased after eyestalk ablation. There is relatively large amount of work on the metabolism of carbohydrates in crustaceans as reviewed by Hohnke and Scheer(1970). It has been shown that the carbohydrate metabolism in the crab, Barytelphusa cunicularis, is controlled by the interaction of two separate factors presentin the eyestalks, namely UDPG glycogen transglucosylase inhibitor and the hyperglycemic factor. The presence of hyperglycemic factor in the eyestalks of Barytelphusa was investigated by Nagabhushanam and Diwan(1971). Diwan(1973) studied the neuroendocrine regulation of glycogen and fat content in the hepatopancreas and muscle tissue of the freshwater crab Barytelphusa cunicularis. He observed that removal eyestalks decreased the concentration of glycogen and fat in the hepatopancreas but there was a rise in the glycogen and fat concentration of muscle tissue. Injection of eyestalk extract brought about reestablishment of glycogen and lipid levels within the normal range in both the tissues.

Madhyastha and Rangnekar(1976) working on the crab, Varuna litterata reported that bilateral ablation resulted in and a fall and rise in the glycogen content of hepatopancreas and muscle respectively. Nagabhushanam and Kulkarni(1980) found in the marine prawn Parapenaeopsis stylifera bilateral ablation has brought significant rise in the glycogen content of the abdominal muscle.

In the present study, in the bilaterally ablated _P. indicus_ there was a remarkable increase in carbohydrate content in muscle. In the hepatopancreas there was a decrease in the carbohydrate content. These observations are in agreement with the earlier observations on crustanceans. It is possible that eyestalk removal in the animal under study accelarates the mobilization of the carbohydrates(glycogen) from the hepatopancreas to the integument and as a result there is a depletion of this metabolite in the hepatopancreas. It may be possible that excess of sugar present in the blood which is obtained through the process of glycogenolysis in the hepatopancreas is quickly mobilized for the synthesis of glycogen in the epidermis and muscle tissue.

SUMMARY

1. Oxygen consumption, ammonia excretion and random (spontaneous) activity of eye ablated (unilateral and bilateral) *Penaeus indicus* acclimated to and tested at 3 temperatures and 5 different salinities were studied. The effect of eyestalk removal on the carbohydrate levels of hepatopancreas and muscle tissue was also investigated.

2. The rate of oxygen consumption increased in unilaterally and bilaterally ablated *P. indicus*. In the case of unilaterally ablated *P. indicus* normal values were obtained 5 hours after ablation and in the case of bilaterally ablated ones the normal values were obtained after 7 hours after ablation.

3. The rate of oxygen consumption increased with increase in temperature in eyestalk ablated (unilateral and bilateral) prawns. The rate of eyeablated females was always found to be higher than that of males.

4. The rate of oxygen consumption of eye ablated *P. indicus* increased with decrease in salinity except in 25.0 ppt where it was found to be the minimum. In the different salinities tested, the rate of oxygen consumption was higher in females than in males.

5. The rate of ammonia excretion increased after eyestalk ablation (both unilateral and bilateral) and the normal value was obtained 6 hours after ablation. The eye ablated females excreted more ammonia than the males.

6. The rate of ammonia excretion after eyestalk ablation increased with increase in temperature and the rate was minimum at 27°C which indicates that the protein degradation is minimal at 27°C.

7. The rate of ammonia excretion increased with decrease in salinity of the medium and it was minimal at 32.4 ppt indicating that the protein degradation is the minimum at 32.4 ppt.

8. The ammonia quotient decreased after eyestalk removal.

9. The ammonia quotients increased with increase in temperature and decreased with increase in salinity of the medium in both unilaterally and bilaterally ablated *P. indicus*. The females had higher A.Q. values than the males. The A.Q. values obtained indicated that relative protein utilization was minimum at 27°C and 32.4 ppt.

10. The random activity of the unilaterally ablated *P. indicus* increased significantly and reached the normal value after 3½ hours whereas the random activity of the bilaterally ablated *P. indicus* which increased markedly after eyestalk ablation reached the normal value after 7 hours.

11. The random activity of the eyestalk ablated prawns decreased with increase in temperature and it was minimum at 27°C.

12. The random activity of the eyestalk removed prawns decreased with increase in salinity and it was minimum at 32.4 ppt.

13. The eye ablated males were found to be more active than females.

14. Eyestalk removal decreased the levels of carbohydrates in hepatopancreas and increased their levels in muscle tissues.

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